Occupational Health and Sleep Issues in Underserved Populations

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KEYWORDS

- Sleep disorders • Sleep health disparities • Burden of occupational injury and illness
- Occupational hazards, injuries and illnesses in underserved worker populations
- Workers' compensation

KEY POINTS

- In the United States, substantial racial, ethnic, and socioeconomic disparities exist in sleep health.
- Poor sleep is associated with a wide range of health effects, and therefore, it is important that primary care physicians working in underserved communities are aware of this disparity and target this higher-risk group for focused evaluation and intervention.
- The workplace, home, and social environment, as well as diet and genetics among other factors, work together to affect an individual's health status.
- Workplace hazards impact one's overall health status, which in turn impact one's ability to obtain, perform, and tolerate work, as well as gain satisfaction from work.
- Primary care physicians should be familiar not only with the type of work an individual does but also with workplace hazards and their effects on individual's health and how to address them.

SLEEP DISORDERS: AN IMPORTANT PUBLIC HEALTH PROBLEM

Historical Background

Sleep and dreams have been a mystery and topics of writings by philosophers, writers, religious leaders, and scientists since the inception of the recorded history.[1] The Greeks and Romans personified sleep through their deities: Hypnos and Somus, respectively.[2] Hippocrates was likely the first writer in the ancient world to mention the

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importance of sleep in general health.[3] In 350 BC, the Greek philosopher, Aristotle, wrote about sleep and waking, whether they are a function of the body or the soul, and the significance of dreams.[4] Interestingly, in 360 BC, historical documents described obstructive sleep apnea (OSA), for the first time: Dionysius, the tyrant of Heraclea, died "chocking on his own fat."[5] Similar writings about sleep and health are found in Egyptian, Indian, and Chinese ancient civilizations and early modern era.[6,7]

In 1836, Dickens wrote about OSA in his work the *Posthumous Papers of the Pickwick Club*, wherein he described "Joe the Fat Boy" as obese and sleepy and a snorer.[8] Thereafter, in 1956, Burwell and colleagues[9] described OSA as Pickwickian syndrome. Electroencephalography changes during sleep and rapid eye movement (REM) were described for the first time by Loomis and colleagues[10] and Aserinsky and Kleitman,[11] respectively. In 1957, Dement and Kleitman[12] identified the stages of sleep. In 1971, Konopa and Benzer[13] discovered the first circadian clock gene in Drosophila. Later in 1972, the suprachiasmatic nucleus (SCN) was discovered as the site of the body's internal circadian pacemaker.[14] Clinicians, scientists, and researchers continue to work toward a greater understanding of the cause and pathophysiology of sleep disorders. Sleep Medicine is developing into an interdisciplinary field in which integration and coordination across the traditional medical specialties, other health care providers such as dentists, and between basic and clinical science are vital.[15]

Scope of the Problem

About 50 to 70 million Americans chronically suffer from a sleep disorder. Sleep-disordered breathing (SDB), including OSA, affects more than 15% of the population and causes excessive daytime sleepiness, injuries, hypertension, cognitive impairment, metabolic syndrome, and an increased risk of heart attack, stroke, and mortality. In children, SDB is associated with cardiovascular and metabolic risk factors, attention-related behavioral problems, and poor academic performance.[16]

Nationwide, 70% of adults report insufficient sleep at least once each month and 11% report such difficulties daily.[17] Nearly 70% of high school adolescents sleep less than the recommended 8 to 9 hours of sleep on school nights.[18] Short and long sleep duration are associated with up to a 2-fold increased risk of obesity, diabetes, hypertension, cardiovascular disease, stroke, depression, substance abuse, and all-cause mortality.[19]

Chronic insomnia is the most common sleep disorder and affects more than 20% of adults. It is a risk factor for depression, substance abuse, and impaired function.[20]

Chronic circadian disorders, including shift work syndrome, affect 20% of the US workforce and is associated with significant safety hazard, increased risk of cardiovascular disease, cerebrovascular disease, breast cancer, colorectal cancer, prostate cancer, obesity, diabetes, gastrointestinal disease, motor vehicle crashes, and difficulty adhering to work schedules.[21,22]

Restless legs syndrome affects 5% of adults and causes sleep onset and maintenance insomnia and subsequent daytime sleepiness.

Another less common disorder is narcolepsy with and without cataplexy affecting 0.05% and 3.9% of population, respectively.

In addition to its deleterious health consequences, the cumulative long-term effects of sleep disorders have a significant economic impact. Billions of dollars a year are spent on direct medical costs associated with doctor visits, hospital services, prescriptions, and over-the-counter medications.[17]

Sleep Health in Underserved Population

In the United States, substantial racial, ethnic, and socioeconomic disparities exist in sleep health. Many studies found that those with longer work hours and lower socioeconomic status report less sleep duration and/or lower sleep quality.[23–25] In a survey of 15,227 Hispanics of low socioeconomic status, Cespedes and his colleagues[26] reported that 28% had insomnia, 19% were short sleepers, and 9% were long sleepers. Grandner and colleagues[27] assessed sleep complaints with a telephone survey of 159,856 participants from across the United States and found that unemployment, being unmarried, lower income, and lower educational attainment were associated with more sleep complaints. Similar findings were reported by other researchers.[28,29]

Because poor sleep is associated with all of the untoward health effects noted above, it is important that primary care physicians (PCPs) working in underserved communities are aware of this disparity and target this higher-risk group for focused evaluation and intervention.

SLEEP PHYSIOLOGY. A *BRIEF* PRIMER FOR THE PRIMARY CARE PHYSICIAN

Sleep-Wake Cycle and Circadian Rhythm

Sleep-wake cycle, which consists of roughly 8 hours of nocturnal sleep and 16 hours of daytime wakefulness, is controlled by 2 internal influences: sleep homeostasis and circadian rhythm. The period of circadian rhythms is about 24 hours in a normal light-dark cycle and is synchronized to the external physical environment and social/work schedules. In humans, light is the strongest synchronizing agent. Sleep-wake cycle is controlled by the suprachiasmatic nucleus (SCN) of the hypothalamus. In addition to providing synchronization in time between various rhythms, the SCN also helps promote wakefulness.[30–35]

It is generally agreed that sleep quality and restfulness are best when the sleep schedule is regularly synchronized to the internal circadian rhythms and the external light-dark cycle and that individuals should go to bed and wake up at around the same time each day.[36–38] Sleep loss results in the accumulation of a sleep debt that must eventually be repaid—by napping or sleeping longer in later cycles. Even the loss of 1 hour of sleep time that accumulates for several days can have a powerful negative effect on daytime performance, concentration, and mood.[39,40] One study recently quoted in the *Economist* states that sleeping 4 hours per night "has the same impact on the performance of various cognitive tasks as a blood-alcohol level of 0.1%, well over the limit for driving a car."[41]

Sleep Architecture

Sleep architecture refers to the basic structural organization of normal sleep. Cycles of non–rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep are recognized by using electroencephalographic recordings. NREM sleep is divided into stages N1, N2, and N3 representing a continuum of relative depth. Each has unique characteristics, including variations in brain wave patterns, eye movements, and muscle tone.[42] The function of alternations between these 2 types of sleep is not yet understood, but irregular cycling and absent sleep stages are associated with sleep disorders. For example, instead of entering sleep through NREM, as is typical, individuals with narcolepsy enter sleep directly into REM sleep.[43]

The individual usually enters sleep through N1 within 10 to 20 minutes after lights out, progressing through stage N2, followed by stage N3, and finally, to REM. However, individuals do not remain in REM sleep the remainder of the night but, rather, cycle between stages of NREM and REM throughout the night every 90 minutes. NREM

sleep constitutes about 75% to 80% of total sleep time, and REM sleep constitutes the remaining 20% to 25%.[44]

Stage N1 sleep serves a transitional role in sleep-stage cycling and constitutes 2% to 5% of total sleep. Stage N2 sleep lasts approximately 10 to 25 minutes in the initial cycle and lengthens with each successive cycle, eventually constituting between 45% and 55% of the total sleep time. Stage N3 is referred to as a slow-wave sleep (SWS), most of which occurs during the first third of the night and constitutes about 15% to 20% of sleep. N3 sleep is important for feeling well rested. It is important in restorative functions, lowering inflammatory cytokines, maintaining hormone balance, and, together with REM, in restorative memory processing.

REM sleep is defined by the presence of desynchronized (low-voltage, mixed-frequency) brain wave activity, muscle atonia, and bursts of REMs. During the initial cycle, the REM period may last only 1 to 5 minutes; however, it becomes progressively prolonged as the sleep episode progresses. The last REM period may last from 30 to 60 minutes. About 4 to 5 REM-NREM cycles occur during night sleep. As the night progresses, stage N3 sleep gets progressively less and the final sleep period is composed mainly of stage N2 and REM sleep. Dreaming is associated with REM sleep with approximately 80% of vivid dream recall resulting after arousal from this stage of sleep. REM sleep may also be important for memory consolidation.[43–48]

Sleep Variants with Age

Neither full-term nor premature neonates show clear circadian rhythm. Newborns usually sleep about 16 to 18 hours per day. Circadian rhythm begins to arise around 2 to 3 months of age, leading to sleep consolidation that manifests in greater durations of wakefulness during the day and longer periods of sleep at night. In young children, sleep amounts decrease as a child gets older. Most children discontinue napping between 3 and 5 years old. Older children are significantly more likely to experience challenges in initiating and maintaining sleep and having nightmares than younger children.[49–56]

Adolescents require 9 to 10 hours of sleep each night. More than a quarter of high school and college students were found to be sleep deprived. Slow-wave sleep (N3) progressively declines with advancing pubertal development; however, time spent in stage N2 increases. These changes are likely in part due to pubertal and hormonal changes that accompany the onset of puberty. With increasing age, the total sleep time and REM sleep decrease, leading to the emergence of normal sleep pattern in adults.[57–59]

Sleep architecture continues to change with age across adulthood. As they age, individuals tend to have earlier wake time. Older adults greater than the age of 65 typically awaken 1.33 hours earlier, and go to bed 1.07 hours earlier, than younger adults, which might be due to an advanced circadian pacemaker that accompanies age. Younger adults may experience brief awakenings, but they are usually minor and occur close to REM sleep transition; thus, sleep remains relatively consolidated. As an individual ages, slow-wave sleep (SWS) declines at a rate of about 2% per decade. Because arousal thresholds are typically highest during SWS, and because SWS declines with age, older adults experience more frequent awakenings during a sleep episode.[60–62]

Elderly show an increase in disturbed sleep that can create a negative impact on their quality of life, mood, and alertness. Although the ability to sleep becomes more difficult, the need to sleep does not decrease with age. Elderly usually suffer both sleep onset and maintenance insomnia, both of which are associated with depression, respiratory symptoms, and physical disability. The progressive decrease in SWS is one of the most prominent changes with aging; however, it appears to preferentially affect men. The reason for the gender difference is unclear.[63–66] Other

prominent factors affecting sleep in the elderly (that are beyond the scope of this text) are a decrease in melatonin levels, changes in sleep latency, nighttime awakenings, inconsistency of external cues such as light exposure, irregular mealtimes, nocturia, and decreased mobility leading to a reduction in exercise.[60–66]

THE IMPACT OF SELECTED SLEEP DISORDERS—WITH SPECIFIC FOCUS ON THE UNDERSERVED

Sleep Deprivation

Sleep deprivation is defined as sleeping less than the recommended 7 to 9 hours of sleep per night. The causes of sleep deprivation are multifactorial. All 4 common sleep disorders mentioned above as well as occupational and lifestyle changes can lead to sleep deprivation.[67] The National Health and Nutrition Examination Survey showed that about 37.1% of US adults report regularly sleeping less than 7 hours per night. Short sleep duration was more common among young adults (aged 20–39 years) and non-Hispanic blacks.[68] Patients with sleep deprivation experience difficulty in concentration, impaired ability to perform daily tasks, lower mental and physical well-being, worsening of chronic diseases, and increased morbidity and mortality.[69,70] Similar findings were reported by other studies.[71,72]

In a cross-sectional survey of 9714 randomly selected subjects, effect of socioeconomic factors on sleep quality was assessed. Sleep quality was strongly associated with poverty level, employment status, and education level.[73] It is postulated that perceived discrimination is a potential cause of sleep disturbance and its resulting heath consequences. In their analysis of data of 7148 adults from Michigan and Wisconsin, Grandner and colleagues[74] found that perceived racial discrimination was associated with increased risks of sleep disturbance (odds ratio [OR] = 2.62, $P<.0001$) and daytime fatigue (OR = 2.07, $P<.0001$). Similarly, in a study of 168 Hispanic-American immigrants, perceived racism was related to increased sleep disturbance and higher levels of depressive symptoms.[75]

Sleep deprivation is associated with wide-ranging effects on the cardiovascular, endocrine, immune, and nervous systems, including obesity, diabetes, impaired glucose tolerance, cardiovascular disease, hypertension, depression, anxiety, fatigue, lack of concentration, increased inflammatory markers, and impairment of functional capacity.[76–82]

Sleep deprivation is also common among adolescents.[83] In a study of 242 healthy adolescents, Troxel and associates[84] found that adolescents from single-parent households had poorer sleep efficiency across the week and shorter sleep duration on weekends. Black adolescents from single-parent households were found to have the lowest weekend sleep efficiency. Inadequate sleep among adolescents has negative consequences for self-regulation and emotional well-being as well as poor school performance, behavioral problems, obesity, insulin resistance, and hypertension.[85,86]

Sleep-Disordered Breathing

OSA is the most common type of sleep-disordered breathing (SDB). It is characterized by loud snoring, breathing interruptions, awakenings, gasping, and choking and usually results in excessive daytime sleepiness.[87–90] OSA is common in adults, with men, older individuals, and the obese being at higher risk. The prevalence of OSA ranges between 2% and 7% with higher prevalence among non-Hispanic blacks.[91–93] In the Sleep Heart Health Study, black men and women had significantly higher Epworth Sleepiness Scores reflecting greater daytime sleepiness.[94] Snoring is the most common reported symptom of OSA; however, awareness of the predominant symptom of

OSA and knowledge of its clinical significance appear to be the lowest among minorities and those with low socioeconomic status and education.[28,95–100]

Epidemiologic and clinical studies suggest that between 35% and 91% of patients with hypertension have OSA.[101,102] A strong racial disparity exists in the prevalence and treatment of hypertension and its relationship to OSA.[103] Jean-Louis and colleagues[101] reported that hypertensive blacks have a 91% prevalence of SDB. A causal association between OSA and hypertension is supported by evidence of a dose-response relationship; the higher the apnea-hypopnea index, the greater the increase in blood pressure. Treatment of OSA by continuous positive airway pressure (CPAP) therapy can reduce blood pressure levels.[104–108] Similarly, OSA is associated with increased risk of other cardiovascular diseases, including arrhythmias, coronary artery disease, myocardial infarction, and congestive heart failure.[109–113] Those with severe OSA have 3-fold higher risk of fatal cardiovascular events. CPAP therapy reduces cardiovascular risk and mortality in patients with OSA.[112,114–118]

OSA is associated with impaired glucose tolerance and insulin resistance especially in those with the highest apnea-hypopnea index. It has been suggested that OSA causes intermittent hypoxia and recurrent sleep arousals, which in turn stimulate the sympathetic nervous system, hypothalamic-pituitary-adrenal axis, and adipocytes with release of catecholamines, cortisol, and inflammatory cytokines and other vasoactive intermediates, which may mediate the development of glucose intolerance, insulin resistance, and, ultimately, type 2 diabetes.[119–121] Babu and colleagues[122] reported that CPAP improved glycemic control in diabetic patients with OSA.

Up to 40% of people who are morbidly obese have OSA. Obesity is a well-established risk factor for the development of OSA and could be a consequence of OSA.[123] OSA-associated obesity might be due to decreased physical activity secondary to excessive daytime sleepiness and/or higher levels of nonfunctional leptin.[124] Significant weight loss usually results in reduction of OSA severity.[125]

Insomnia

Insomnia is the most commonly reported sleep disorder. Insomnia could be sleep-onset insomnia; difficulty to initiate sleep or sleep maintenance insomnia; or difficulty to maintain sleep. Insomnia could result in daytime consequences, such as tiredness, lack of energy, difficulty concentrating, and/or irritability.[126,127] Insomnia affects between 15% and 20% of adults in the United States. However, prevalence increase was noted recently among young adults, elderly, women, whites, Hispanics, diabetics, and patients with joint pain.[128,129] Family history of insomnia, low socioeconomic status, stressful lifestyles, medical and psychiatric disorders, and shift work are other risk factors for insomnia.[130–134]

Daily experiences of discrimination, workplace harassment and incivilities, and other stressors are significant factors for poor sleep quality and insomnia.[135,136] In a study of 1289 pregnant Latinas, Manber and colleagues[137] found that depression, lack of social support, and low income were significant risk factors for insomnia; however, strong family ties, group identity, and English proficiency were protective factors.

Insomnia is conceptualized as a state of hyperarousal. The exact causes of insomnia are poorly understood. Biological, psychological, and social factors might play a role in insomnia pathogenesis. Adults with insomnia have higher levels of cortisol and adrenocorticotropic hormone, reduced cortisol awakening response, and flattened diurnal cortisol profile. Studies suggest that insomnia might be due to overactivity of multiple neural systems, particularly brainstem, hypothalamus, and basal forebrain. In addition, limbic and paralimbic structures that regulate basic emotions and instinctual behaviors, such as the amygdala, hippocampus, ventromedial

prefrontal cortex, and anterior cingulate cortex, have been shown to be abnormally active during sleep in individuals with insomnia.[138–141]

Pain is another major risk factor for insomnia. Bazargan and colleagues[142] found that patients with a level of pain of 5 or higher (on a scale of 0–10) showed a higher level of insomnia. Cognitive factors, such as worry, rumination, and fear of sleeplessness, light exposure, non–regular sleep schedule, and exposure to trauma, increase the odds of insomnia.[105,143] Chronic insomnia is associated with increased risk of cardiovascular diseases, such as acute myocardial infarction, hypertension, arrhythmias, cerebrovascular diseases, diabetes, psychiatric disorders, and all-cause mortality.[144–147]

Circadian Rhythm Disorders

Circadian rhythm sleep disorders are persistent or recurrent patterns of sleep disturbance due to misalignment of the circadian clock in relation to environmental cues and the terrestrial light-dark cycle. They usually cause insomnia, excessive sleepiness, or both and are associated with impairment of social, occupational, or other functions. Delayed sleep phase and advanced sleep phase disorders are the most common circadian rhythm disorders.[148]

Delayed sleep phase syndrome is characterized by sleep onset and wake times that are typically delayed 3 to 6 hours relative to conventional sleep-wake times. On the other hand, advanced sleep phase syndrome is characterized by involuntary bedtimes and awake times that are more than 3 hours earlier than societal means. In both conditions, the amount of sleep is not affected.[149] Circadian rhythm disorders are more prevalent in adolescents and young adults.[150,151] Biological, physiologic, and genetic factors play an important role in pathogenesis of circadian rhythm disorders. Nightshift workers are at higher risk for delayed sleep phase syndrome due to irregular circadian entrainment. Similarly, individuals who live in extreme latitudes and are exposed to extended periods of light may also be at increased risk.[152–156] Polymorphisms in circadian clock genes have been identified in familial delayed and advanced sleep phase syndromes.[157–159] Delayed and advanced sleep phase syndromes impair an individual's job performance and are associated with marital problems and financial difficulty. In adolescents, they are associated with increased daytime irritability, poor school performance, and psychiatric disorders.[150]

Treatment of delayed sleep phase syndrome requires resynchronizing to a more appropriate phase to the 24-hour light-dark cycle. In addition to a structured sleep-wake schedule and good sleep hygiene practices, potential therapies include resetting the circadian pacemaker with bright light, melatonin, or a combination of both.[160] Treatment options for individuals with advanced sleep phase syndrome are limited. Bright light therapy in the evening has been used successfully.[161] It is also hypothesized that administration of low levels of melatonin in the early morning may also be used.[162]

Restless Leg Syndrome

Restless leg syndrome (RLS) is one of the most common movement disorders with a prevalence of 5%. It is more common in older adults and women; however, it may be found in adolescents and teenagers. It is characterized by an irresistible urge to move the legs, which worsens during rest or inactivity, especially in the evening and at night, causing most individuals difficulty falling asleep. It also may affect the arms, trunk, or head and neck. It may also be associated with paresthesias, which individuals describe as creepy-crawly, jittery, itchy, or burning feelings. The symptoms are partially or completely relieved by movement. Individuals with RLS often experience

periodic limb movements; however, periodic limb movement disorder is not always associated RLS.[163–167]

RLS affects more than 20% of pregnant women secondary to transient low levels of ferritin and folate; therefore, they typically disappear within 4 weeks after delivery.[168] It may also be associated with attention-deficit hyperactivity disorder (ADHD). Chervin and colleagues[169] reported that ADHD symptoms were almost twice as likely to occur with symptoms of RLS as would be expected by chance alone.

The exact cause of RLS is not completely understood. It likely results from altered dopamine and iron metabolism. RLS commonly occurs in individuals with iron deficiency, including end-stage renal disease, iron-deficiency anemia, pregnancy, and bariatric surgery. Iron is necessary for the synthesis of dopamine and the activity of the D_2 dopamine receptor. In patients with RLS, reduced iron levels were noted in the substantia nigra, which is responsible for controlling voluntary movement through neurons that rely on dopamine as a neurotransmitter. The association between dopamine, iron deficiency, and RLS is further supported by observations that dopamine antagonists cause worsening of RLS symptoms, while dopamine agonists are used to treat RLS. There is strong evidence for genetic predisposition, in which susceptibility gene loci have been identified on chromosomes 12q, 14q, and 9p; however, no genetic markers are currently available.

There is early evidence that RLS is more common in underserved communities, with one recent survey noting RLS symptoms greater than 3 times per week in more than 10% of rural poor respondents.[170] Higher rates have also been seen in older patients, women, those with lower socioeconomic status, those with lower education, and those unemployed, retired, or disabled, and non-Hispanic whites.[170,171] Dopaminergic agents are the primary treatment option for individuals with RLS.[169–184]

In conclusion, the PCP working in underserved areas should be aware of the common sleep disturbances discussed above, their untoward health effects, and their increased incidence among underserved populations. Treatment approaches can be complex and often require multidisciplinary interventions, but the potential rewards in patient well-being, societal benefit, and physician satisfaction make addressing such issues paramount.

OCCUPATIONAL HEALTH IN UNDERSERVED POPULATIONS

Occupational Health Services for Underserved Populations

Historical context

Occupational health and safety is the field pertaining to the health and safety of the workforce and lies at the interface between work and health.[185] Workplace hazards impact one's health status, which in turn impacts one's ability obtain, perform, and tolerate work as well as gain satisfaction from work. Not only is it important for the PCP to know the type of work an individual does but also to be familiar with the workplace and its hazards, whether physical, chemical, biologic, mechanical, or psychosocial, will assist the astute PCP to render optimal care to their working patients. The workplace, home, and social environment, as well as diet and genetics among other factors, work together to affect an individual's health status.[186]

The PCP might overlook work-related causes of injury and illness if an index of suspicion does not exist.[187] The focus may be placed on fitting the presenting signs and symptoms into a nonoccupational cause when the diagnosis may be right at hand if occupation is queried. As such, all patients who present to their PCP should be queried as to their occupation.[188] This simple question is imperative, because many workers may not seek care from an occupational and environmental medicine

(OEM) physician for a work-related injury or illness for several reasons. They may not realize that their injury or illness is work related; they may not have access to an OEM physician; they may not know how to report a work related event, or they may fear reprisal.[189] As many as 25% of visits to PCPs are for work-related conditions.[190] It is in understanding a patient's work that, through educating the patient on preventive measures, future similar injuries may be prevented.[191] Indeed, approximately one-quarter of physicians have no work history recorded in their chart.[192]

Workers' compensation

Workers' compensation insurance covers workers whose injuries or illnesses arise out of work. The oldest form of social insurance in the United States and the third largest source of support for disabled workers after Social Security and Medicare, the Workers' compensation system started during the early part of the twentieth century for the purpose of providing monetary compensation for medical and rehabilitation costs and lost wages to certain workers with work-related injuries or disabilities. The Workers' compensation system can be credited for helping to create a more humane environment for covered workers. Workers' compensation statutes are based on the legal principle of "exclusive remedy" whereby an injured employee can only claim compensation within the system. Workers in effect have given up the right to sue the employer at common law. In return, the injured employee receives total reimbursement for the medical costs incurred as well as full or partial wage replacement during the period during which the employee was unable to work. The United States does not have a unified Workers' compensation law because each state, federal jurisdiction, and territory have individual systems, statutes, and regulations. As such, the PCP may need to be familiar with the law in the area in which they practice.[193]

Some categories of workers are excluded from Workers' compensation protection. This includes workers employed by companies with 5 or fewer employees, agricultural workers, domestic (household) workers, casual laborers, independent contractors, the self-employed, business owners and partners, and state, municipal, and nonprofit institution employees. In addition, Workers' compensation insurance is not compulsory for most private employment in some states.

Health status of underserved workers

Underserved workers have various vulnerabilities. They may not fall under the protection of Workers' compensation[193] and may also have no private medical insurance.[194–196] In the event they are insured under Workers' compensation, they may be unaware of their eligibility of the Workers' compensation laws or they may be in the country illegally and as such may not want to come forward for fear of deportation, even if the injury or illness is work related.[197] The PCP may also be unaware of their patient's eligibility.[198]

In general, underserved workers have an unequal increased burden of chronic disease.[199–202] Chronic disease, if unrecognized and untreated, may delay recovery from a work-related injury[203] or even render a worker more prone to occupational injury or illness.

Often in the Workers' compensation arena, the occupational medicine physician may be the only physician the worker sees for an extended period of time. Given that workers must often work in a job for a minimum period of time before medical insurance is available to them, there may be a financial barrier to timely referral to primary care. On the other hand, a worker may present to the PCP for treatment of an injury that is not recognized as work related. The PCP may focus on the newly

diagnosed chronic disease, such as hypertension and diabetes, without taking steps toward educating the worker on how to prevent such an injury or illness form recurring or getting worse.

Burden of occupational injury and illness

The magnitude of occupational disease and injury burden is underestimated but significant.[204] In 2014, private industries in the United States reported nearly 3.0 million nonfatal workplace injuries and illnesses—a rate of 3.2 cases per 100 equivalent full-time workers.[205] The public sector reported 5.7 cases among full-time state and local workers, such as police and firefighters, with almost half the injuries being sprains and strains. The 5 industries reporting the greatest workplace risk are the health care and social assistance sector (8.3/100 workers); transportation and warehousing (5.2/100 workers); arts, entertainment, and recreation (4.8/100 workers); agriculture, forestry, fishing, and hunting (4.8/100 workers); and manufacturing (4.4/100 workers).[206]

Regulations and Regulatory Bodies

The Occupational Safety and Health Administration

The Occupational Safety and Health Act of 1970 (OSH Act) signed into law in 1970 led to the establishment of the Occupational Safety and Health Administration (OSHA) and the National Institute of Occupational Safety and Health (NIOSH). The OSH Act contains the "General Duty Clause," which places a duty on the employer to provide a safe workplace and was created to cover all possible hazards, not just those that could be foreseen at the time. In general, the working environment has become "safer" since OSHA was created; there has been a reduction in workplace injuries and fatalities.[207] However, injury and illness do remain and are undercounted in underserved workers, who routinely work the more hazardous trades and who may not report or seek treatment due to fear of reprisal.[189]

OSHA is the agency of the Department of Labor that enforces the regulatory mandates of the OSH Act by setting standards, rules, and regulations by which covered employers are expected to conduct business. Its purpose is to prevent work-related injuries, illnesses, and occupational fatalities by issuing and enforcing standards for workplace safety and health. However, OSHA has limited resources such that it is unable to inspect every workplace that needs inspection. Priority is given to more dangerous situations or otherwise targeted inspections.[208]

NIOSH, a part of the Centers for Disease Control and Prevention, is the primary federal agency conducting research on the safety and health of the workplace and providing recommendations for the prevention of work-related illnesses and injuries. The National Occupational Research Agenda (NORA) is the research framework for NIOSH and the nation. Based on critical issues in workplace safety and health identified by stakeholders, goals and objectives are developed to address work-related injuries and diseases.[209] NORA places an explicit emphasis on worker populations that have been underserved, such as immigrant workers, health care workers, and hotel workers, among others.[210]

Selected Underserved Worker Populations: Hazards, Injuries, and Illnesses

Health care workers

Health care workers (HCWs) are within the sector with the highest rate of occupational injury (health care and social assistance sector), yet 11% are underserved in they have no health insurance.[211,212] The uninsured HCW is more likely to be young, unmarried, African American or Hispanic, to have lower income, and to work part time, and is less

likely to have a college degree. Within this group, home health aides have the highest rate of uninsurance at 23.8%; licensed practical nurses are next at 14.5%, and then registered nurses at 5%. Nursing home workers were more likely to be uninsured than hospital-based workers with a rate of 20% compared with 8.2%.[213]

Despite being among the least insured in this sector, workers at nursing and residential care facilities experience the highest rate of workplace injuries and illnesses, with 8.3 incidents per 100 employees, whereas hospital-based health care workers saw an incidence rate of 7.0 per 100 employees. Ambulatory health care services and social assistance were more in line with the cross-industry average, with incidence rates of 2.8 and 3.5 per 100 employees, respectively.[206]

Injuries in this industry are mostly due to heavy lifting when handling patients[214] and exposure to blood-borne pathogens.[215] Home HCWs (home health aides, personal/home care aides, companions, nursing assistants, or home health nurses), among the least insured and most underserved in this sector, provide hands-on long-term care and personal assistance to clients with disabilities or other chronic conditions in patients' homes and in community-based services such as group homes. They have little control over their work environment, where in addition to encountering hazards, such as blood-borne pathogens, other biological hazards, and ergonomic hazards, may also encounter violence, latex, hostile animals, animal waste, tripping hazards, hazards on the road as they drive from home to home, overexertion, stress, guns and other weapons, illegal drugs, verbal abuse, temperature extremes, unhygienic conditions, lack of water, and otherwise dangerous conditions.[214]

With lack of insurance come delays in seeking care, fewer prevention visits, and poorer health status.[211] As such, if these underserved workers present, the PCP may be able to use this as an opportunity to try to address other issues such as chronic disease[216] and psychological strain,[217] if present. Even with insurance, these HCWs may be less likely to file a Workers' compensation claim.[189] The astute PCP will query appropriately regarding the work relatedness of the injury or illness, thus optimizing the visit and not only treating the injury or illness but also counseling on prevention of further similar work-related injury or illness. The Bureau of Labor Statistics (BLS) projects home health care employment as the fastest growing occupation for this decade.[218] The PCP, being aware of their working conditions, will be better able to serve them.

Hotel workers

The hotel employee is another demographic that is underinsured. Many room attendants are immigrant or minority women, with most being Asian, Latin American, or African American.[219] Migrant and many immigrant workers are not covered by labor legislation and fear losing their jobs and hence livelihood.[189] Immigrants comprise 39.7% of maids and housekeeping cleaners[220] and are less likely to report an injury or illness that occur and also less likely to file a Workers' compensation claim.[206]

Despite this, hotel workers have higher rates of occupational injury and sustain more severe injuries than those in the service sector as a whole[221] with an overall injury rate in housekeepers at ~5.2 injuries per 100 worker-years. The highest rate was found for Hispanic housekeepers (10.6/100) with acute trauma rates highest in kitchen workers (4.0/100). Independently associated risk factors for injury in these workers are older age, female gender, and being Hispanic. In general, Hispanic workers have the highest rate of fatal and nonfatal OSHA-reported injuries in the United States, followed by black non-Hispanic workers.

The workload of hotel housekeepers that results in high injury and illness rates surpassing the national average involves physical hazards such as constant

repositioning, changing body postures, including bending, kneeling, lifting, stooping, squatting, twisting, and pushing[221] during room cleaning work, which is physically strenuous. They are also exposed to chemical hazards, such as cleaning products, and biological hazards, such as blood and waste.[222] They are also at risk for psychological distress as they experience conflicts within the workplace.[223] In addition, they often work isolated with little interaction with other housekeepers while on the job,[224] which can contribute to psychosocial stress.

The astute PCP will give optimal care within this context with an eye to prevention, in terms of both chronic disease and work-related injury and illness prevention as well as psychosocial support. The worker may not attribute their symptoms to work for fear of reprisal, in the case of immigration issues, the fear of deportation, for example, and this may affect the amount of information the worker shares with the PCP.[225–227]

International Occupational Health

Burden of occupational injury and illness worldwide

Exposure to occupational hazards results in a significant proportion of the burden of disease and injury worldwide.[228] Much could be prevented using prevention strategies.[229] According to the International Labor Organization (ILO), 6300 people die every day as a result of occupational accidents or work-related diseases: more than 2.3 million deaths per year. There are 317 million accidents on the job annually. Many of these incidents lead to extended absences from work. There is a vast human cost of this daily adversity. Indeed, the economic burden of poor occupational safety and health (OSH) practices is estimated at 4% of global gross domestic product each year.[230] Employers face issues such as costly early retirement, absenteeism, loss of skilled staff, and high insurance premiums, due to work-related accidents and diseases. According to data from the World Health Organization, occupational risk factors are responsible for 8.8% of the global burden of mortality due to unintentional injuries. This is thought to be an underestimate due to underreporting. These global data are inadequate as they do not include intentional injury at work or commuting injury. Known prevention strategies implemented widely would diminish the avoidable burden of injuries in the workplace.[231]

Regulation and enforcement

In 2003, the ILO adopted a Global strategy to improve occupational safety and health (OSH), which included the introduction of a preventive safety and health culture, the promotion and development of relevant instruments, and technical assistance. The ILO Constitution set forth the principle that workers should be protected from sickness, disease, and injury arising from their employment. ILO standards on OSH provide essential tools for governments, employers, and workers to establish such practices and to provide for maximum safety at work because many of these tragedies can be prevented through implementing sound prevention, reporting, and inspection practices. ILO Codes of Practice provide practical guidelines for public authorities, employers, workers, enterprises, and specialized OSH protection bodies. These instruments are not legally binding and are not intended to replace the laws, regulations, or standards in various countries. They provide guidance on safety and health at work.[232] More recently, ILO devised a Plan of Action toward a significant reduction in the unacceptable human suffering and economic losses that are still caused by work-related accidents and illnesses worldwide. ILO affirms the right to “decent, safe and healthy working conditions and environment.”[233]

An example of parallel legislation to protect workers in 3 systems are the OSH Act in the United States,[234] legislation in Canada through the Canadian Centre for

Occupational Health and Safety (CCOHS, 2015[235] and the Health and Safety at Work Act of Britain[236]). Other countries may base their legislation on these. The OSH Act passed with the goal to "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions" places the responsibility for eliminating or minimizing hazardous conditions on the employer.[234] The CCOHS stipulates that an employer is to "exercise due diligence to implement a plan to identify possible workplace hazards and carry out corrective action to prevent accidents or injuries arising from these hazards,"[235] whereas The Health and Safety at Work Act of Britain[236] stipulates that "employers are to ensure as far as reasonably practicable, the health, safety and welfare at work of all his employees."

SUMMARY

As employers, governments, and national and international organizations work toward improving the health and safety of all workers, the road toward improved worker health will continue to be made clearer. There are inequities in that some workers are afforded care, whereas others are afforded suboptimal care or no care at all. Poverty and marginalized status in societies play a role. Indeed, in the United States, health insurance and Workers' compensation insurance are usually tethered to full-time employment so this safety net is only available to covered lives. Even so, workers with a real or perceived barrier to seeking care for a related injury or illness, covered or not, will not receive this benefit. Prevention is the optimal way to improve worker health and safety. As the science improves and occupational health and safety becomes more mainstream, PCPs will be increasingly equipped to help workers and worker populations attain high-quality, longer lives free of preventable disease, disability, injury, and premature death.[237]

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