

Sleep Habits and Sleep Disturbances in Industrial Workers in Israel: Main Findings and Some Characteristics of Workers Complaining of Excessive Daytime Sleepiness

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Summary: Detailed data about sleep habits, sleep complaints, life style, work, past and present health were obtained from 1,502 industrial workers. In agreement with previous studies, one-third of the workers reported having problems with sleep. A relatively large percentage of workers complained of excessive daytime somnolence (EDS), which was unrelated to sex, age, education, and area of origin. Compared to the total population, workers complaining of EDS had significantly more pre- and postsleep complaints, midsleep disturbing phenomena, and work accidents, and they were less satisfied with their work. They also had a significantly higher prevalence of asthma, high blood pressure, headaches, and arthritis and ulcers, and they consumed significantly more medications. Based on the cluster of pre- and postsleep complaints of workers complaining of EDS, and on preliminary results from the second phase of this project (which includes laboratory polysomnographic recordings), it is suggested that in most cases, various forms of breathing disorders in sleep are responsible for EDS. **Key Words:** Sleep complaints—Industrial workers—Excessive daytime somnolence—Breathing disorders.

Few studies have investigated the prevalence of sleep disturbances in the general population, in contrast to the large number of sleep laboratory studies investigating sleep disorders in selected groups of insomniac or hypersomniac patients. Bixler et al. (1979) reported that 42.5% of a sampling of 1,000 representative households in the Los Angeles metropolitan area gave complaints of insomnia. Of these, 22.9% complained of midsleep awakenings, 14.4% had trouble falling asleep,

Received for publication February 1981.

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13.8% complained of early morning awakenings, and 4.2% complained of hypersomnia. Overall, women complained more than men, and complaints increased with advancing age. Earlier, the same investigators reported an 18% incidence of insomnia and a 3.1% incidence of hypersomnia based on data obtained from 4,358 physicians in various specialties (Bixler et al., 1976).

McGhie and Russell (1962) investigated the sleep habits of 2,446 Scottish subjects and reported that elderly females had the greatest incidence of sleep disturbances and the highest rate of hypnotic usage. Karacan et al. (1976) obtained information on sleep disorders from a random sample of 1,645 individuals in Alachua County, Florida, and reported that more than a third of the respondents had problems with sleep. More than half of these respondents had difficulties falling asleep, 15.3% reported difficulties staying asleep, and 6.5% complained of insufficient total sleep time. Only 0.5% complained of "too much sleep."

In a general health and attitude survey conducted in the Houston metropolitan area, Thornby et al. (1977) reported that 33% of the respondents reported difficulty falling asleep at least "sometimes," and 9% reported taking sleeping pills at least "sometimes." In this study also, women complained more than men, and complaints increased with advancing age. Kripke et al. (1979) analyzed data for more than a million adults and reported that 5.5% of the males and 13.6% of the females complained of experiencing insomnia "often" or "fairly often." Females also reported a much greater use of sleeping pills than did males. In both sexes, the incidence increased with advancing age. In this prospective study, increased mortality was associated with both long sleep (10 hr or longer) and short sleep (5 hr or less). Extreme sleep durations were almost as good predictors of mortality as history of diabetes, heart disease, stroke, and/or high blood pressure.

Lavie et al. (1979) recently reported on the prevalence of sleep complaints obtained from 1,502 workers during an exhaustive annual and preemployment medical examination. Overall, 19.7% complained about their sleep: 5.8% complained of difficulties falling asleep, 6.9% of frequent awakenings, 2.6% of both, and 4.4% of excessive sleep. Complaints of frequent awakenings increased significantly with advancing age. The present study was conducted to investigate in more detail the prevalence of sleep disturbances in industrial workers in Israel and the relationship of sleep disturbances, particularly of excessive daytime sleepiness (EDS), to work factors and work accidents. The study consisted of two parts: a field survey of the sleep habits and sleep disturbances of a large population of industrial workers, and a follow-up phase of sleep laboratory recordings of selected groups of workers. The present report focuses on the major findings of the field survey and illustrates some typical characteristics of workers complaining of EDS.

METHODS

Population

The population investigated in the present study consisted of 1,502 industrial workers, 84% male and 16% female. All were permanent day workers, sampled from a wide geographical area, which included the largest industrial cities in

Israel. Workers were individually interviewed by trained interviewers in more than 250 factories. Population distributions regarding age and country of origin were identical to the corresponding distributions obtained from the Israeli National Statistical Bureau for civilian industrial workers for 1979. The distributions were also similar regarding years of education and family status. A large difference existed, however, regarding sex: women were underrepresented in the investigated population (16%) as compared to their actual percentage in the total civilian industrial work force (36%).

The Questionnaire

The sleep questionnaire used in the present study consisted of 72 questions grouped in several sections: demographic data, sleep habits (hours of sleep on weekdays and weekends, time of sleep, etc.), complaints related to nocturnal sleep, complaints related to EDS and napping behavior, life style, work conditions and work accidents, past and present health, and drug use. The construction of the questionnaire was based on data obtained from a sample of 60 workers in 4 factories and from data obtained from 200 patients referred to the Technion Sleep Laboratory because of various sleep disturbances. Most questions were "closed items," and after the interviewer presented the question, the worker had to choose from four possible answers: "never," "seldom," "many times," or "always," or between two possible answers: "yes" and "no."

RESULTS

The results are presented in two sections. First, data about sleep habits and sleep complaints are described, and then data of workers complaining of EDS are compared to the rest of the experimental population. Statistical comparisons are made with the χ^2 test, performed on response percentages in each of the four or two possible categories. Whenever possible, parametric statistical tests were applied.

Sleep Habits

About 60% of the population reported regular bedtimes, during both weekdays and weekends. Modal bedtime during weekdays was 2300–2400 hr (33.1%), but almost as many workers retire at 2200–2300 (30.4%); 4.1% retire earlier than 2100, and 1.3% of the population retire later than 0100. Bedtimes on weekends did not differ much from weekdays, except for an increase in the percentage of workers retiring after 1 a.m. (15.4 vs. 1.3%).

The most favored activities during the 15 min immediately prior to bedtime were reading (32.4%), drinking water (19.1%), smoking (18.4%), eating a light snack (12.2%), and drinking coffee (9.8%) or tea (8.0%). Interestingly enough, 33% of the smokers reported smoking the last cigarette up to 5 min before going to sleep.

Modal sleep time on weekdays was 6 hr (mean, 6.46 ± 1.17) and 7 hr on weekends (mean, 7.55 ± 1.91), but as many as 17.5% of the workers reported sleeping 5 hr or less, and 1% reported sleeping 10 hr or more. Modal estimated sleep latency was 10–20 min (33.4%), and 10.2% reported sleep latency of at least 30 min "always" or "many times".

In the morning, 52.9% woke up spontaneously, while the rest were awakened either by an alarm clock or by another person. Only 7.5% of the workers reported "always" taking an afternoon nap; 8.9% take a nap "many times," 32.1% "sel-dom," and 51.6% "never."

Pre- and Postsleep Complaints and Disturbing Midsleep Phenomena

Many workers complained of various symptoms as they attempt to fall asleep. The most common complaints were feelings of worries and tension (reported "always" or "many times" by 12.0%¹), pain in different parts of the body (7.5%), sweating and feeling hot (7.5%), headaches (7.2%), and difficulties breathing and suffocation (5.8%). Paralysis of the legs and disorientation were reported by 0.7% and 1.6%, respectively.

The most prevalent disturbing midsleep phenomena were excessive movements in sleep (33.2%), snoring (18.5%), excessive leg movements (9.6%), talking in one's sleep (3.6%), and sleepwalking (0.4%).

As in the case of presleep symptoms, many workers complained of various symptoms upon awakening in the morning. The most common complaints were headaches (5.5%), pain in different parts of the body (4.7%), sweating and feeling hot (4.3%), difficulties breathing and suffocation (3.0%), worries and tension (1.4%), disorientation (1%), and paralysis of the legs (0.5%). Fifteen percent of the workers reported "always" or "many times" waking up in the morning in a "bad mood."

Midsleep Awakenings

Seventeen percent of the workers reported at least one midsleep awakening. Of these, 51.8% reported one awakening, 29.2% reported 2 awakenings, 12.7% reported 3 awakenings, and 6.1% reported 4 awakenings or more.

Excessive Daytime Sleepiness

As reported above, 16.4% of the workers regularly take a nap in the afternoon; some, however, reported involuntary somnolence under various conditions. Fifteen percent reported a need to sleep during the day, 3.5% reported snoozing during work breaks, and 2.6% admitted that they have to stop working to take a short nap. Many workers reported a tendency to fall asleep in passive and less demanding activities: watching TV (30.6%), traveling (16.9%), reading (14.5%), at movies or plays (5.0%), and during lectures (3.4%); and 1.1% reported falling asleep while visiting friends. Some 119 workers (103 males, 16 females) reported falling asleep "always" or "many times" in at least two of the above six activities; of these, 35 (33 males, 2 females) reported falling asleep in at least three activities.

¹ Unless indicated otherwise, the reported percentages represent the percentage of workers answering "always" plus "many times" in each item.

Sleep Complaints, Sex, Age, Area of Origin and Education

Five exclusive sleep complaint groups were formed in order to further investigate the relation of sleep complaints to several demographic variables: (1) "Difficulties falling asleep" (group F) included all the workers who reported sleep latencies of at least 45 min "always" or "many times," but who did not complain of midsleep awakenings or EDS; (2) "Midsleep awakenings" (group W) included all workers reporting midsleep awakenings "always" or "many times," but who did not complain of difficulties falling asleep or EDS; (3) "Frequent awakenings and difficulties falling asleep" (group FW) included all the workers reporting the combination of both, but who did not complain of EDS; (4) "Excessive daytime sleepiness" (group EDS) included all the workers reporting falling asleep in at least two of the six activities outlined above, but who did not complain of either difficulties falling asleep or of midsleep awakenings; and (5) "Midsleep awakenings, difficulties falling asleep, and EDS" (group FWEDS) included workers reporting the combination of all three complaints.

Sex

Table 1 gives the sex representation in each of the five groups. Overall, 29.9% of the workers reported some sleep disturbances, with women complaining more than men (38 vs. 28.2%). The difference between men and women, however, was significant only in group F (12.1 vs. 6.0%, $\chi^2 = 7.66$, $p < 0.01$), although a large difference was also found in group FW (7.1 vs. 2.7%). The smallest difference was in group EDS (5 vs. 4.6%).

Age

Figure 1 presents the age distribution in each of the groups for males and females. Males showed significant age trend in group W, with a 4-fold increase in complaints from 5% at 18-24 to more than 20% at 55+ years ($\chi^2 = 30.96$, $p <$

TABLE 1. Incidence and sex distribution of workers by sleep complaint group

Sleep complaint ^a	Incidence of complaint (%)		
	Total	Male	Female
Difficulties falling asleep (F) ^b	7.5%	6.6%	12.1%
Midsleep awakenings (W)	11.2	10.8	12.1
Excessive daytime somnolence (EDS)	4.9	5.0	4.6
Difficulties falling asleep and midsleep awakenings (FW)	3.4	2.7	7.1
EDS and difficulties falling asleep and midsleep awakenings (FWEDS)	2.9	3.1	2.1
Total complaints	29.9	28.2	38.0

^a Group abbreviation in parentheses.

^b $p < 0.01$.

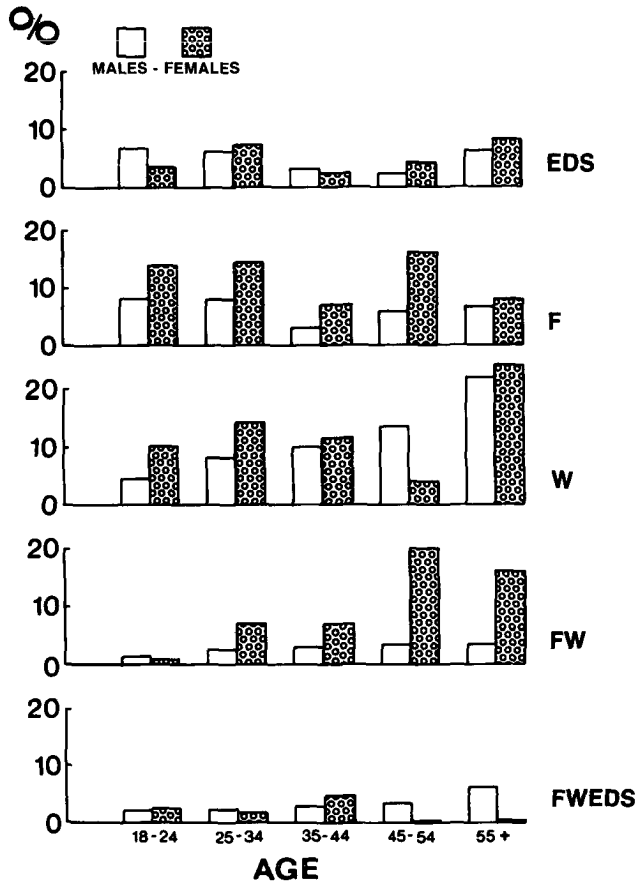


FIG. 1. Percentage of workers in each group with respect to age. *Abbreviations:* F, difficulties falling asleep; W, midsleep awakenings; FW, frequent awakenings and difficulties falling asleep; EDS, excessive daytime somnolence; FWEDS, midsleep awakenings, difficulties falling asleep, and EDS.

0.01). Females showed a significant age trend in group FW, with a 20-fold increase from about 1% at 18–24 years to 20% at 45–54 years ($\chi^2 = 12.50, p < 0.01$).

Area of Origin

Figure 2 presents the percentages of males and females in the five groups as a function of three areas of origin: Israel, Asia and Africa, and Europe and America. No significant differences were found among the groups.

Years of Education

Figure 3 presents the percentages of males and females in each of the complaint groups as a function of years of education. Males showed significantly fewer difficulties falling asleep with increasing levels of education ($\chi^2 = 19.28, p < 0.01$). When both sexes were pooled, a similar relationship was also obtained in group FW ($\chi^2 = 12.98, p < 0.05$).

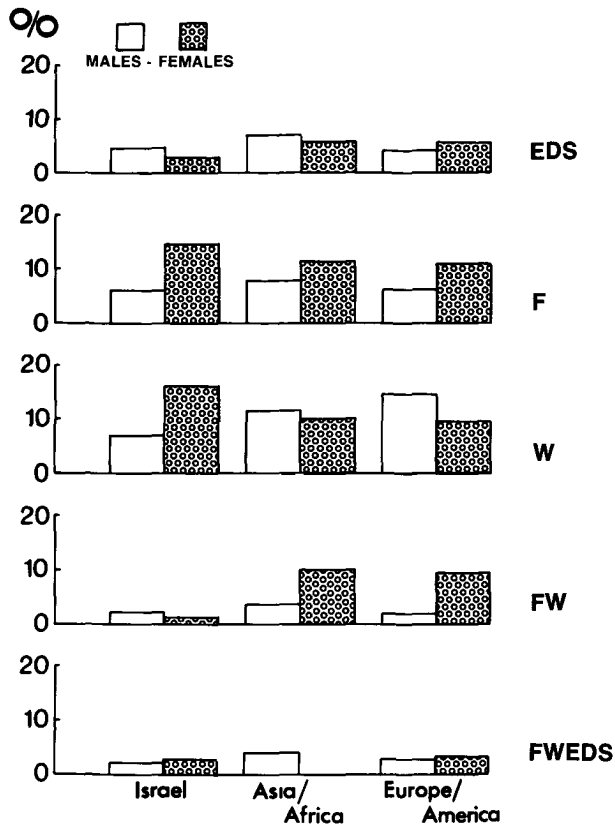


FIG. 2. Percentages of workers in each group with respect to area of origin. Abbreviations are as in Fig. 1.

Characteristics of Workers Complaining of EDS

One of the main purposes of the present project was to investigate the influence of sleep habits and sleep disturbances on workers' life styles, health, and work safety; therefore, the data of workers complaining of EDS were compared with the rest of the population (groups EDS plus FWEDS). Also, the influence of the severity of EDS was examined by comparing data of workers reporting a tendency to fall asleep "always" or "many times" in two activities only (EDS 1, $n = 84$) to those of workers reporting a tendency to fall asleep in three or more activities (EDS 2, $n = 35$). Since it is possible that EDS is the result of heavy physical effort during the day, further analyses were made controlling for the amount of diurnal physical effort.

Demographic Variables

The sex distribution of workers with EDS did not differ significantly from that for the total population, and there were no significant differences between the EDS group and the rest of the population with respect to age, family status,

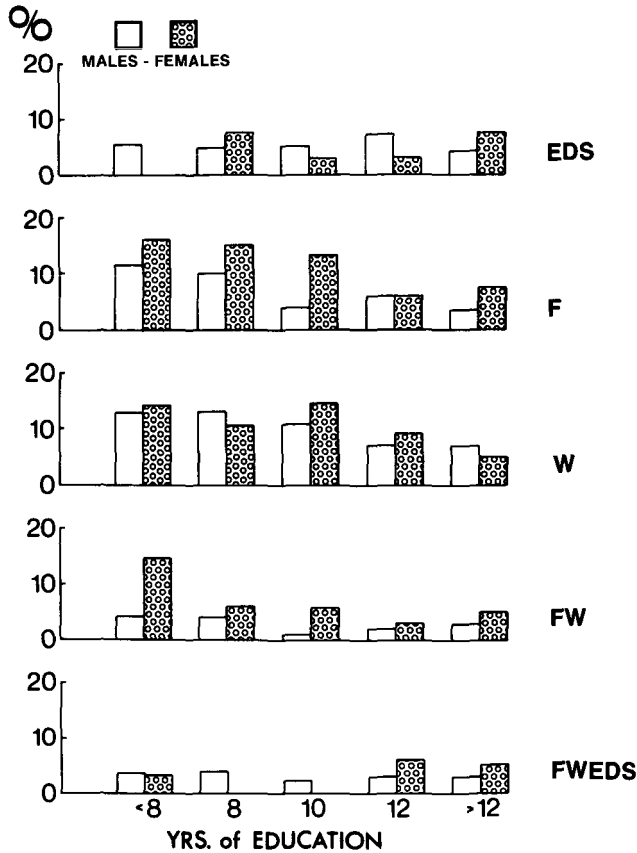


FIG. 3. Percentages of workers in each group with respect to years of education. Abbreviations are as in Fig. 1.

education, country of origin, or height/weight ratio. The average age of the EDS group was 37.9 ± 14.53 years as compared to the average of 36.97 ± 13.68 for the rest of the population.

Sleep Habits

No significant differences were found between sleep habits of the EDS group and the rest of the population except for a higher tendency of EDS workers to drink before sleep. Significant differences were found with respect to drinking water (21 vs. 13%, $p < 0.001$), coffee (12.6 vs. 6.2%, $p < 0.03$), and soft drinks (6.7 vs. 4.3%).

Sleep Complaints

Workers complaining of EDS reported significantly more sleep latencies of 60 min or longer (10.9 vs. 4.8%, $p < 0.007$), and they complained significantly more of almost all presleep symptoms. The most common complaints were tension (19.8

vs. 11.2%, $p < 0.0001$), pains in different parts of the body (19.4 vs. 6.5%, $p < 0.0001$), sweating and feeling hot (21.9 vs. 6.3%, $p < 0.001$), and difficulties breathing and suffocation (16.8 vs. 4.8%, $p < 0.0001$).

Similarly, EDS workers reported significantly more midsleep awakenings (30.2 vs. 15.8%, $p < 0.006$), and after waking up during the night, they tended significantly more often to leave the bedroom and eat (21 vs. 10.4%, $p < 0.0004$) or to take analgesics (7.6 vs. 2.8%, $p < 0.0001$). They also found it much more difficult to return to sleep after midsleep awakenings (26 vs. 15.1%, $p < 0.007$). Additionally, significantly more EDS workers complained of postsleep symptoms: the most common complaints were headaches (15.1 vs. 4.7%, $p < 0.0001$), sweating and feeling hot (15.1 vs. 3.4%, $p < 0.0001$), worries (10.1 vs. 5%, $p < 0.0001$), and dizziness (8.4 vs. 3%, $p < 0.0001$). Significantly more EDS workers woke up from sleep in a bad mood (11.9 vs. 3.2%, $p < 0.06$).

Disturbing Midsleep Phenomena

The EDS group complained significantly more of snoring (29.4 vs. 18.3%, $p < 0.006$), excessive movements in sleep (52.1 vs. 31.5%, $p < 0.0001$), leg movements (20.2 vs. 8.7%, $p < 0.0005$), and somniloquism (7.6 vs. 3.3%, $p < 0.008$).

Daytime Sleepiness

As expected, the EDS group complained significantly more than the rest of the population of various aspects of daytime sleepiness. They reported significantly more need for diurnal sleep (42.9 vs. 12.6%, $p < 0.001$), and more snoozing during work breaks (14.2 vs. 3.5%, $p < 0.001$); and significantly more workers had to stop work in order to take short naps (16.8 vs. 1.4%, $p < 0.0001$).

Work Factors

By far the most striking significant difference between the EDS group and the rest of the population regarding work factors was in the prevalence of work accidents (52.1 vs. 35.6%, $p < 0.0005$). Significant differences were also found with respect to a list of disturbing work-related factors. The most significant ones were: interpersonal tensions (51.3 vs. 29.3%, $p < 0.00001$), work pressure (46.2 vs. 29.2%, $p < 0.0002$), smoke (45 vs. 29%, $p < 0.0004$), gases (39 vs. 28%, $p < 0.01$), ventilation (29 vs. 19%, $p < 0.01$), and cold environment (22 vs. 14%, $p < 0.01$). Significantly fewer workers in the EDS group were satisfied with their work ($p < 0.03$).

Health and Medications

The EDS group had a significantly greater degree of hospitalization (63 vs. 52.4%, $p < 0.03$) than the rest of the population. They also evidenced a greater percentage of asthma (3.4 vs. 0.9%, $p < 0.05$), high blood pressure (13.4 vs. 7.3%, $p < 0.03$), frequent headaches (26.1 vs. 15.8%, $p < 0.005$), arthritis (5.9 vs. 2.2%, $p < 0.03$), and ulcers (7.6 vs. 3.6%, $p < 0.05$). And they complained significantly more of generally disturbed sleep (17.6 vs. 6.4%, $p < 0.0001$). The use of

analgesics (25 vs. 13.2%), antacid medication (14 vs. 4.9%), and stimulants (4 vs. 0.2%) was also significantly more frequent in the EDS group ($p < 0.009$, 0.02, and 0.02, respectively).

Severity of EDS and Physical Effort

Few significant differences were found between groups ESD 1 and EDS 2. Workers in EDS 2 reported significantly more midsleep awakenings (51 vs. 31%, $p < 0.005$) and obviously complained significantly more of a tendency to take short naps during work breaks (28.6 vs. 11.9%, $p < 0.05$). Although in the EDS 2 group there were relatively fewer women than in EDS 1 (16.9 vs. 5.7%), the difference was short of statistical significance ($p < 0.18$).

Relation to Diurnal Physical Effort

To control for the amount of physical effort, the workers complaining of EDS were divided into four subgroups according to their reported amount of physical effort involved in their work. These were: "very strong" ($n = 24$), "strong" ($n = 32$), "medium" ($n = 46$), and "slight" ($n = 16$). Then, the four groups were compared with each other for all variables outlined above regarding sleep habits, sleep complaints, medical history, etc. No significant differences were found among the groups for any of the variables related to sleep habits and sleep complaints. Workers who reported "very strong" effort during the day complained significantly more of some of the adverse work factors, such as smoke ($p < 0.006$), dust ($p < 0.006$), and work pressure ($p < 0.06$).

DISCUSSION

The percentages of sleep complaints obtained in the present study and their age and sex distributions are in general agreement with previous findings by McGhie and Russell (1962), Bixler et al. (1979), Thornby et al. (1977), Karacan et al. (1976), and Lavie et al. (1979). In all studies, about one-third of the respondents reported some sleep disturbances at least sometimes; complaints increased with advancing age, particularly for midsleep awakenings; and females complained more than males. Although we could find no comparable data regarding the relationship between years of education and sleep complaints, the significant inverse relationship between the incidence of difficulties falling asleep and its combination with midsleep awakenings and years of education agree with the inverse relationship between socioeconomic status and difficulties falling and staying asleep reported by Karacan et al. (1976) in an urban Florida county.

The resemblance in the overall rate of complaints and in the type of interactions between sleep complaints and demographic variables in studies carried out in such remote areas (e.g., Scotland, urban Florida county, Los Angeles Metropolitan area, and Israel) imply that sleep disturbances are minimally affected by cultural differences in sleep-wake habits, a conclusion further supported by the lack of significant effects of area of origin on sleep complaints in the present study.

In contrast to previous studies, however, additional data were obtained in the

present study on pre- and postsleep complaints and on disturbing midsleep phenomena. Also, a conscious effort was made to focus on complaints regarding EDS rather than on complaints regarding initiating and maintaining sleep. There were three main reasons for shifting the emphasis from insomnia to EDS. First, the chief complaint of at least 50% of the patients referred to the Technion Sleep Laboratory in the last 2 years was EDS rather than insomnia; second, our earlier study (Lavie et al., 1979), as well as the recent report by Bixler et al. (1979), suggested a much higher prevalence of EDS than what was previously thought, 4.2 and 4.4%, respectively; third, data accumulated in our sleep laboratory indicate that most of the patients complaining of EDS suffer from various forms of breathing disorders during sleep.

The findings that 4.9% of the total investigated population complained of EDS and that an additional 2.9% complained of EDS in combination with difficulties falling asleep and midsleep awakenings, indeed support the previous suggestion of a much higher prevalence of EDS than was considered formerly. The prevalence of EDS is even more impressive when different aspects of EDS are considered separately. While 7.8% complained of a tendency to fall asleep in at least two passive and undemanding activities, 3.5% reported falling asleep during job breaks and 2.6% admitted that they have to stop working to take a short nap.

Somewhat more surprising was the wealth of sleep- and work-related complaints associated with EDS. Workers complaining of EDS, as defined by a tendency to fall asleep in two of six passive and undemanding activities, complained significantly more of all pre- and postsleep complaints, as well as of disturbing midsleep phenomena. The most prevalent complaints were of presleep tension, pain in different parts of the body, sweating and feeling hot, and difficulties breathing and feelings of suffocation. They also awoke significantly more often from sleep and found it much more difficult to go back to sleep. After awakening in the morning they significantly more often suffered from headaches, sweating and feeling hot, worries, and difficulties breathing and feelings of suffocation. And they complained significantly more of snoring, excessive movements, and somniloquism during sleep.

This cluster of pre- and postsleep complaints, as well as disturbing midsleep phenomena, shows a remarkable resemblance to the type of complaints presented by patients complaining of EDS due to breathing disorders in sleep. Midsleep awakenings, heavy snoring, and excessive motility in sleep, as well as frequent headaches and difficulties breathing and feelings of suffocation, are prevalent in patients with sleep-related breathing disorders. Further, the difficulties at work due to interpersonal tensions, including work pressure, reported by 50% of the workers complaining of EDS, and complaints related to ventilation (smoke, gases, climate) reported by more than a third of these workers, are also typical of patients complaining of EDS due to breathing disorders in sleep.

This close resemblance strongly implicates sleep-related breathing disorders as the main underlying etiology in the complaint of EDS among the workers studied here. This conclusion is further supported by preliminary results from the second phase of this study, which have been presented in a preliminary form (Lavie et al., 1980). Whole-night polysomnographic recordings performed on a sample of work-

ers complaining of EDS revealed a large proportion of workers with breathing disorders in sleep. Based on these preliminary data, some 1.5% of the total population actually have disruptive sleep patterns due to various forms of sleep-related breathing disorders. It should be emphasized that these preliminary estimates are the lower limits of the true prevalence in the population.

Even accepting the conservative estimate of EDS due to breathing disorders in sleep to be in the neighbourhood of 2–3% of the total adult (mostly male) population, the number of afflicted people is enormous. This brings up some unavoidable questions regarding diagnostic criteria and diagnostic strategies, as well as about treatment procedures. Large-scale studies of EDS patients that utilize polysomnographic techniques are no doubt essential to provide the necessary practical answers. Such studies appear even more urgent in light of the grave effects of EDS on workers' well-being (e.g., higher rates of work accidents, less job satisfaction, higher rates of drug usage, etc.) observed in the present study.

ACKNOWLEDGMENTS

Supported by the Ministry of Labour and Social Affairs. The valuable help of Mr. S. Kremerman, Ms. N. Nave, and Ms. M. Weil is greatly appreciated.

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