Received: 4 December 2019 | Revised: 10 January 2020 | Accepted: 6 February 2020

DOI: 10.1002/1348-9585.12116

REVIEW ARTICLE

Journal of Occupational Health Open Access WILEY

Shift work and migraine: A systematic review

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Abstract

Objectives: Migraine is a chronic neurological disorder characterized by recurrent attacks of headache, mainly affecting the working age population with a great socio-economic impact. The etiology of migraine is still uncertain, and various individual and/or environmental risk factors have been suggested as triggers of the attacks, including irregularities in the sleep-wake rhythm. In this perspective, it is possible that shift and night work, affecting circadian rhythms, may play a key function in the disease pathogenesis. Therefore, aim of this review was to provide an overview on the possible association between shift works and migraine development or clinical outcomes.

Methods: A systematic review of literature studies available in Pubmed, Scopus, and ISI Web of Science databases, addressing the possible shift work-migraine relationship was performed.

Results: Conflicting data emerged from the revised studies. Some results supported a positive association between migraine prevalence and shift works, according to peculiar job tasks, seniority in shift works, specific work schedules, and number of night shifts performed in a month. However, other investigations failed to confirm such findings.

Conclusions: The limited number of available studies, their cross-sectional nature, the different criteria employed for migraine diagnosis, and the various shift work schedules analyzed, together with exposure to other confounding factors on workplace do not allow to extrapolate definite conclusions on shift work-migraine relationship. From an occupational health perspective, further studies appear necessary to better understand such exposure-disease association and possibly define risk assessment and management strategies to protect the health of susceptible and/or migraine affected workers.

KEYWORDS

migraine, night work, occupational risk factors, risk management, shift work, work schedule

1 | INTRODUCTION

Migraine is a chronic paroxysmal neurological disorder characterized by recurrent attacks of moderate or severe headache lasting from 4 to 72 hours.[1] Typical characteristics of the migraine headache are unilateral location, throbbing or pulsating quality, aggravation by routine physical activity and head movements, as well as the association with photophobia, phonophobia, gastrointestinal symptoms such as nausea and emesis, as well as cutaneous allodynia and dizziness.[2]

According to the WHO, migraine, with its annual prevalence of 12%, is the third most prevalent medical illness and the second most disabling neurological disorder in the world.[3-5]

It generally affects individuals in their most economically productive age, between 20 and 55 years, with a two to three times greater prevalence in women than men.[6,7] Overall, migraine has an impressive socioeconomic impact on society due to the deterioration of patients' quality of life,[8] the increase in medical and psychiatric comorbidities,[9,10] medical costs, and loss of productivity representing one of the leading causes of years lost to disability.[11-15] The financial implications of the disease represent also a societal concern with annual costs estimated to be in excess of $20 billion.[16,17]

Despite vascular, neurogenic, and neuroinflammatory theories would seem to contribute to describing the complexity of the pathophysiology of migraine,[18] the etiology of the disease is still uncertain, and various risk factors have been suggested as triggers of the attacks. Among these are changes in hormonal levels in women,[19] sleep disturbances including lack or excess of sleep, changes in daily routines such as meal times, work, and rest cycles.[20,21] Also, circadian disruption, referred as the malalignment of the internal circadian rhythm with the external environment, has been described to possibly stimulate migraine attacks.[22,23] In this perspective, shift work intended as a "a method of organization of working time in which workers succeed one another at the workplace so that the establishment can operate longer than the hours of work of individual workers," and night work defined as "working at least 3 hours of the daily shift or a certain proportion of the yearly working time in a period of 7 hours defined by national law and including the time from midnight to 05:00" may have a triggering role.[24,25] These require workers to be on duty during their biological resting phase and to be forced to schedule sleep according to their biological active phase. These aspects disturb sleep patterns and quality potentially increasing the risk of migraine onset.[26] This seems further supported by the evidence that migraneurs frequently report poor sleep quality which is associated with increased disease frequency and severity.[20,27-30] Considering that in Europe, about 20% of the working population is involved in shift works, it appears evident the importance to understand shift-work-related consequences on migraine.[31] Therefore, aim of the present review was to provide an updated overview on the association between shift works and migraine onset as well as on the possible relationship between specific work schedules and disease manifestations, disabilities, and chronicity. This may be useful to point out critical aspects that may need attention for the assessment and management of risks derived from such peculiar occupational organization, as well as to identify specific conditions of hypersusceptibility that require peculiar occupational medicine caution.

2 | MATERIALS AND METHODS

A systematic search of PubMed, Scopus, and ISI Web of Science databases was used to identify studies published until 1 October 2019 evaluating the possible association between shift works and migraine according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement (PRISMA) criteria (Figure 1).[32] The search strategy included the key terms "shift work*" to assess the exposure context and "migraine" as the outcome of the investigation, which were combined with the Boolean operator "AND." Two of the authors independently examined all titles and abstracts retrieved and selected articles that met the inclusion criteria. Studies eligible for inclusion were all types of human peer-reviewed research articles (ie, cross-sectional, cohort, case-control studies, case series), published in English and exploring migraine in shift workers. Studies published in languages other than English, review and conference papers, as well as publications not specifically focusing on the association between migraine and shift works have not been included. The preliminary search retrieved 9, 23, and 23 references through PubMed, Scopus, and ISI Web of Science databases, respectively, for a total of 55 articles. In all, 19 duplicates were removed and 36 articles remained. Among those, studies that did not meet the inclusion criteria were excluded according to the following reasons: 24 were removed because studies out of the topic from the title and abstract analysis; four were excluded as conference papers; two were removed as in languages other than English. Indeed, six publications could be identified in this preliminary phase. The reference lists accompanying published articles were also scanned to identify additional relevant studies allowing the inclusion of two further eligible articles. All full texts of the articles considered valuable for the aim of our review were obtained and a critical evaluation was performed. Overall, our search retrieved a total of eight publications for review.

3 | RESULTS

Several studies investigated the potential role of circadian rhythm disruption, caused by shift-works and night-shift

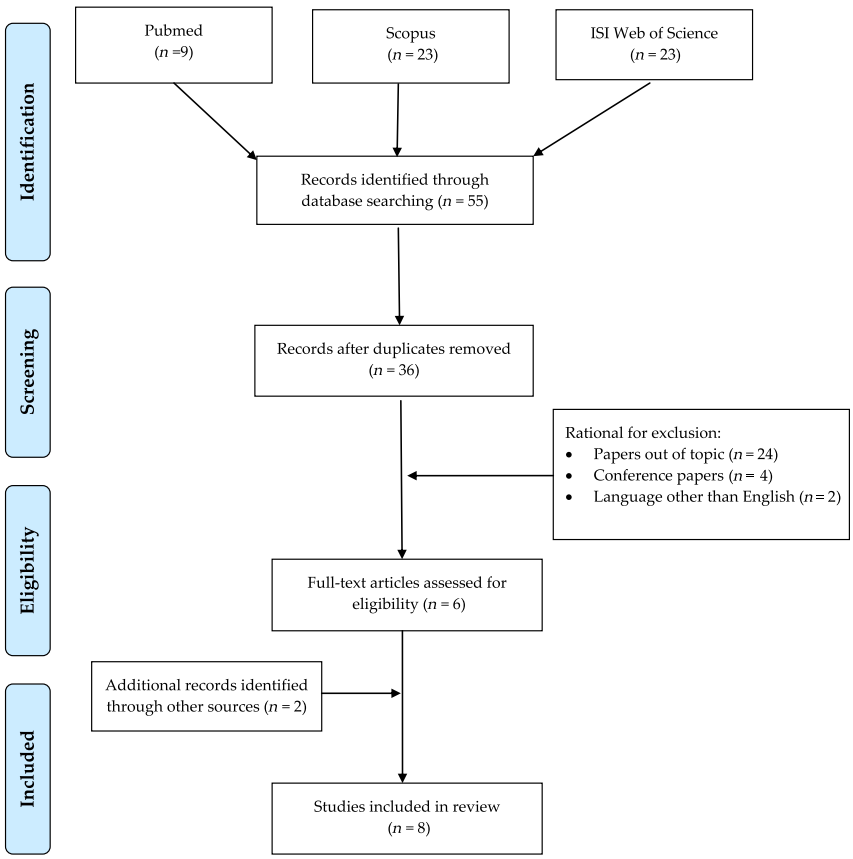

FIGURE 1 Flow diagram of literature search

works, as risk factors for migraine onset and possible migraine triggers themselves, although obtaining no conclusive results (Table 1).

Healthcare professionals (HCPs), frequently employed on rotating shift works, have been studied for their risk of migraine.[33,36,37,39] Wang et al[36] investigated the prevalence of primary migraine and associated organizational risk factors among Chinese female nurses. The authors demonstrated a 1-year prevalence of migraine of 14.8% in nurses compared to 12.8% reported in the general population in a previous nationwide-based study[41]: 3.4% migraine with aura and 11.4% migraine without aura. The prevalence of migraine and total headache in this group of workers did not significantly differ with work arrangements with 36.7% in day shift workers and 30% in rotating workers including day, evening, and night shifts. Concerning the impact of the frequency of night shifts on the migraine, they found that nurses working more than eight night shifts per months had a significantly greater risk to suffer for the disease (29.4%) compared to those working less than eight night shifts per month (18.9%). As an ulterior factor associated with migraine, work seniority ≥5 years was significantly associated with a greater prevalence of the disease compared to workers with a lower length of employment. However, it is important to note that as the seniority increased, nurses shouldered a greater work pressure and face more complicated personal relationship, which may all function as leading causes of migraine attacks.

Jakobsen et al[38] studied the association between treatment-seeking migraine and shift work, categorized as fixed day (working time mainly in between 06 and 18); fixed evening (working time mainly in between 15 and 24), fixed night works (working time mainly in between 00 and 05); and variable working hours with and without nights in a Danish general working population. The prevalence of treatment-seeking migraine was 7.2%, 11.6%, and 2.7%, for fixed day, evening, and night workers, respectively, and 5.9% for shift workers with night work and 8.6% for shift workers without night work. The authors reported that participants with fixed evening work had 56% increased odds of treatment-seeking migraine compared with subjects with fixed day work. An additional analysis was conducted to investigate whether the association between shift work and treatment-seeking migraine differed by seniority. This could demonstrate that, among participants with a seniority of <10 years, fixed evening workers did not have significantly higher odds compared with fixed day workers, while when a seniority of at least 10 years was considered, the odds of treatment-seeking migraine were significantly increased. Furthermore, the authors investigated whether the association between shift work and treatment-seeking migraine was explained by differences in sleep length, number of weekly working hours, and self-reported stress. Sleep length (≤6 hours: OR: 1.49, 95% CI: 1.21-1.85) and self-reported stress (moderate stress: OR: 1.58; 95% CI: 1.25-2.00 and high stress: OR: 2.55, 95% CI:

TABLE 1 Studies assessing the relationship between shift work and migraine

Study location (analyzed period)	Study design	Population investigated (number) and age	Outcome	Occupational risk factors for migraine	Additional information	Results	Reference
Brazil (2000)	Cross-sectional	Nurses from 2 public hospitals (n. 258 F) Mean age: 37.4 ± 7.4 y (range 17-64 y)	Migraine prevalence	Night shift works	*Migraine diagnosis:* reports of migraine in the 2 wk before the survey *Working schedule* • Night shift: 19-7 h/60 h off • Day shift: 7-19/ 60 h off	• Lower prevalence of migraine in the 2 wk before the survey in night vs day shift workers (PR: 0.71; 95% CI: 0.55-0.92) • Lower prevalence of migraine in night than day-only workers (PR: 0.74; 95% CI: 0.57-0.96) • No significant differences in sleep complaints between night and day shift workers	Portela et al (2004)[33]
Canada (1994-1999)	Prospective cohort	National Population Health Survey in Canada (n. 6062 individuals) Age range: 18-74 y	Migraine incidence	Working schedule	*Type of working hours*: • Regular shift with or without weekend; • Rotating/split with or without weekend • Irregular/other	• New migraine cases between 1994-1995 and 1998-1999: 275 • Incidence: 12.7/1000 person-years in the full cohort; 6.9 for M; 21.0 for F • No association was evident with respect to the type of working hours compared to regular organization: regular with weekend (RR 1.75; 95% CI: 0.44-1.26); rotating/split (RR 0.69; 95% CI: 0.32-1.47); irregular (RR 1.08; 95% CI: 0.57-2.03)	Kopec and Sayre (2004)[34]
Central Sweden (March-May 2000)	Cross-sectional	General working population (n. 22 871) Age range: 18-64 y	Recurrent headache (RH) and/or migraine prevalence	Working schedule	*Migraine diagnosis:* reports of migraine in the 3 mo before the survey *Working schedule* • Dichotomized into daytime and others (evening, night, shift work and other)	• Prevalence of RH/migraine: no significant association between different working schedule • Daytime M workers (11.0%) vs other than daytime M workers (13.4%) • Daytime F workers (24.5%) vs other than daytime F workers (27.3%)	Molarius et al (2008)[35]
Mainland, North China (December 2013-June 2014)	Cross-sectional	Nurses from various departments of 3 hospitals (n. 1023 F) Mean age: 27 y (range 20-57 y)	Migraine prevalence	Working schedule	*Migraine diagnosis:* made according to the International Classification of Headache Disorders, 3rd edition (1-y prevalence) through a telephone interview conducted by a neurologist. *Working pattern* • Rotational shifts • Number of night shifts per month	• Migraine prevalence: 14.8%; 95% CI: 9.2% -24% (migraine with aura 3.4%; migraine without aura 11.4%) • Seniority (≥5 y vs <5 y) was a risk factor for migraine (OR: 2.280; 95% CI: 1.323-3.929) • Working >8 night shifts per month was associated with increased migraine prevalence (OR: 1.79; 95% CI: 1.12-2.85) compared to those working ≤8 night shifts per month	Wang et al (2015)[36]

(Continues)

TABLE 1 (Continued)

Study location (analyzed period)	Study design	Population investigated (number) and age	Outcome	Occupational risk factors for migraine	Additional information	Results	Reference
Taiwan (2007-2011)	Prospective cohort	Healthcare workers (n. 218 319); non-healthcare professionals (n. 218 319)	Migraine incidence/ migraine risk	• Rotating night shift	*Investigated subgroups* • Physicians (n. 50 226, mean age: 44.42 ± 12.15 y) • Nurses (n. 122 357; mean age: 33.55 ± 8.76 y) • Other healthcare professionals (HCPs), pharmacists, technicians, dietitians, rehabilitation therapists, social workers (n. 45 736; mean age: 38.37 ± 10.88 y) • Comparison non-healthcare cohort (n. 218 319: mean age: from 33.55 ± 8.76 to 44.42 ± 12.15 y)	• Cumulative incidence rates of migraine (5 y): 1.51% in physicians, 28% in nurses, 1.96% in other healthcare professionalsMigraine risk compared to the general population: physicians AOR: 1.672; 95% CI: 1.468-1.905; nurses AOR: 1.621; 95% CI: 1.532-1.714; other HCPs AOR: 1.254; 95% CI: 1.124-1.399 • Nurses and physicians had higher migraine risks than other HCPs (AOR: 1.303; 95% CI: 1.206-1.408, and AOR: 1.193; 95% CI: 1.069-1.332, respectively)	Kuo et al (2015)[37]
Copenhagen, Denmark (April-December 2012)	Cross-sectional	Danish working population (n. 5872%-39% M; 61% F) Mean age: 45.4 ± 11.5 (range: 18-64 y)	Migraine prevalence	• Shift works and night works	*Prevalent job categories* Managers (n. 695); healthcare workers (n. 681); school teachers (n. 644); pedagogues (n. 590); store sellers (n. 485) *Working pattern* • Fixed day work (06-18) • Fixed evening work (15-24) • Fixed night work (00-05) • Variable working hours including or not night shift works	• Prevalence of treatment-seeking migraine: 7.2%, 11.6%, 2.7%, 5.9%, 8.6% for fixed day, fixed evening, fixed night worker, shift workers with night work, and shift workers without night work, respectively (no significant differences) • Significantly increased odds for migraine in fixed evening workers compared to fixed day workers: OR: 1.47; 95% CI: 1.0003-2.16) • Fixed evening workers (<10 y seniority) had no significantly higher odds for treatment-seeking migraine compared with fixed day workers (OR: 1.32; 95% CI: 0.81-2.17). Fixed evening workers (at least 10 y seniority), the odds of treatment-seeking migraine were significantly increased (OR: 2.47; 95% CI: 1.25-4.90)	Jakobsen et al (2017)[38]

(Continues)

TABLE 1 (Continued)

Study location (analyzed period)	Study design	Population investigated (number) and age	Outcome	Occupational risk factors for migraine	Additional information	Results	Reference
Norwey (2014—the 6th wave of an annual follow-up started in 2008)	Cross-sectional	Nurses (n. 1585; 95% F) Mean age in 2008:32.5 ± 8.5 y	Migraine prevalence	Work schedule	*Migraine diagnosis:* made according to the International Classification of Headache Disorders, 3rd edition (1-y prevalence) *Work pattern* • Day only; • Night only • Two-shift rotations (day and evening) • Three-shift rotation (day, evening, and night) • Number of night shift worked in the previous year • Number of quick return (defined as less than 11 h between consecutive work shifts) in the previous year	• Migraine prevalence in the total sample: 19.2% • No significant differences in migraine prevalence according to work schedule: day only (22.6%); two-shift rotation (20.3%); night shift only (16.3%); three-shift rotation (18.8%) • No significant differences in migraine prevalence according to night shifts: 0 night shifts (21.9%); 1-20 night shifts (18.0%); >20 night shifts (18.1%) • No significant difference in migraine prevalence according to quick returns: 0 quick returns (22.1%); 1-20 quick returns (18.9%); >20 quick returns (19.1%)	Bjorvatn et al (2018)[39]
Toronto, Canada (2011-2018 period of migraine follow-up)	Case series	Two-shift working patients with migraine.	Case series follow-up	Night shift work	*Patients characteristics* • Subject A: a 47-y-old male working in public transit with a history of migraine of 15 y • Subject B: a 34-y-old female nurse with migraine	• Both patients initially reported severe migraine headache-related disability and noted a worsening of their headaches after beginning night shift work • Both improved when switched back to day shifts, then worsened upon being put back on night shifts • Their headache patterns finally reverted from chronic to episodic migraine after eliminating night shifts completely and maintaining a good sleep routine	Sandoe et al (2019)[40]

1.99-3.28), but not number of weekly working hours, were associated with a higher occurrence of migraine. However, the association between shift work and treatment-seeking migraine did not change adjusting for these three variables one by one.

Kuo et al[37] studied migraine risk in three different groups of HCPs, including physicians, nurses and other HCPs, such as pharmacists, technicians, dietitians, rehabilitation therapists, social workers, compared to each other and to the general population in Taiwan. The cumulative incidence rates of migraine were 1.51% in physicians, 3.28% in nurses, and 1.96% in other HCPs. Physicians, nurses, and other HCPs had a significantly higher migraine risk compared to the non-healthcare general population. Compared with other HCPs, nurses had the highest significantly migraine risk and physicians the second highest. Although rotating night shift sleep disturbances was suggested as one of the most important risk factors for migraine occurrence, possible confounding role of other factors characterizing such professions, including heavy workload and emotional stress cannot be ruled out, and need deep investigation.

Conversely, Molarius et al[35] found no association between working hours, dichotomized into daytime and others (ie, evening, night, shift work, and other), and recurrent headache/migraine, as self-reported symptoms occurred in the 3 months before the survey in a Swedish working population. On the other side, these authors could point out a strong association with psychosocial working conditions, that is, dissatisfaction with work as well as worry about losing one's job. This may support the key role of stress and mental tension, more than work schedule as common triggers for migraine occurrence. Additionally, also other lifestyle factors, such as physical inactivity, as well as socioeconomic issues, that is, economic problems and particularly experiences of being belittled, may have a possible influencing role in migraine manifestation. Comparably, Kopec and Sayre[34] failed to find significant association between the type of working schedule, that is, regular hours, regular hours with weekend, rotating shifts, irregular schedule, with respect to migraine headaches development in a Canadian population. Portela et al[33] reported a decreased odd for migraine among current night working nurses in Brazil. In this study, the comparison between night and day shift workers revealed that migraine headache requiring medical care during the 2 weeks before the survey were more prevalent among day than night workers. On one side, this result may be related to a possible "healthy worker effect" evident in those employees involved in night shifts, but, on the other side, it may be affected by the greater exposure of day workers to some risk factors, such as stress.

In nurses participating in a Norwegian cohort study, the prevalence of different types of headache was studied in relation to work schedule that was classified as day only, two-shift rotation (day and evening), three-shift rotation (day, evening, and night), and night only. Number of night shifts worked in the previous year and number of quick returns (defined as less than 11 hours between consecutive work shifts) experienced during the previous year were also addressed. The authors failed to detect any significant differences between the migraine prevalence with respect to work schedule, and the number of night shift works or quick returns. However, the prevalence of migraine was significantly higher among nurses with shift work disorders, intended as difficulties in sleeping or experiencing excessive sleepiness related to the work schedule.

Interestingly, in a recent case series study, Sandoe et al[40] described two-shift workers with severe migraine headache-related disability, who suffered a worsening of their headache after beginning night shift work. Both improved when switched back to day shifts, and worsened coming back on night shifts. After eliminating night shifts completely and maintaining a good sleep routine, their headache patterns finally reverted from chronic to episodic migraine. This overall may suggest that shift work appeared to be associated with chronicity of migraine and higher headache-related disability despite optimal headache management and good patient adherence.

4 | DISCUSSION

Migraine is a chronic and debilitating disease that finds triggering agents in both individual and environmental risk factors, including sleep disturbances and changes in daily routines.[42] In this perspective, it appears important to define the possible role of shift and/or night shift working, as occupational schedules affecting workers' circadian rhythms, and thus, potentially influencing disease onset and clinical history. This appears an even more challenging issue for the public and occupational health, considering that the disease primarily involves individuals in their most economically productive age. Migraine is responsible for an impaired quality of life,[43,44] an increased incidence of disability,[44] and use of healthcare resources, therefore causing direct and indirect costs for public health and workplace due to absenteeism and presenteeism.[45]

Although some positive results suggest the relationship between shift work and migraine, in terms of night shifts performed in a month,[36] seniority in shift works[38] as well as job tasks performed (HCPs vs non-HCPs; nurses, physicians vs other HCPs),[37] other evidences failed to support such association,[33-35,39] therefore preventing to extrapolate definite conclusions. In this scenario, some critical aspects should be considered when interpreting these results. The first one relates to the different criteria employed to make migraine diagnosis. In fact, not all the studies were able to use the International Headache Society diagnostic criteria

for classification of headache disorders,[46] and most of them used self-reported symptoms of migraine.[35] This may characterize a recall bias in assessing shift work-migraine relationship, since self-reported information may overestimate cases of disease but also fail to identify all cases of migraine that are not recognized by patients. Moreover, different periods of time were considered to diagnose migraine cases, that is, the presence of disease symptoms during 2 weeks,[33] or 3 months before the investigation,[35] while other investigations evaluated the 1-year prevalence of the disease.[36] This may characterize a potential difference in the power to detect cases of migraine among different studies, therefore preventing a suitable comparison between each other. Additionally, also the cross-sectional nature of the majority of the analyzed investigations limits conclusions about a casual association between peculiar occupational working schedule and migraine manifestations. In some cases, in fact, the relationship may be bidirectional and cannot be pointed out through this kind of experimental design. Future longitudinal research should be conducted to investigate the causality/directionality of the association between migraine and organizational work variables.

The lack of an association between shift work and migraine, as determined in some early studies on the topic,[33,34] could be related to the fact that different types of shift workers were classified into one or two general categories and that seniority of employment was not taken into account. Additionally, these unexpected results could be explained also by "the healthy worker effect" which means that workers who maintain a night job are better able to withstand its deleterious effects.[33,39] At the contrary, workers employed in a day work may have health problems that contraindicate night work, therefore leading to underestimate possible negative effects of shift works.[39] However, it cannot be excluded also the possibility that the exposure to other certain risk factors on workplace, such as the typically high workload, and the consequent stress experienced by workers during the daytime, that is, in public hospitals due to the large number of people seeking during the daytime, may be responsible for the greater deleterious effects of day shifts compared to the night work with respect to migraine prevalence. In this regard, it may be important to define whether circadian misalignment, as occurs in shift and night workers, may trigger migraine in itself, and the possible confounding role of other occupational risk factors.[39]

Several studies have suggested impaired sleep as a potential pathway between shift work and poor health and several studies suggest sleep loss and deprivation as triggers of migraine due to the induced circadian rhythm alterations.[47,48] Kuo et al[37] suggested that healthcare professionals, especially nurses, who generally work on rotating shifts or night shifts, may suffer from sleep problems, that is, difficulty in falling to sleep, sleep deprivation, and poor sleep quality. This may be responsible for the greater migraine risk detected in this job category compared to non-HCPs. This is in line with the results obtained by Bjortnvan[39] who demonstrated that the prevalence of migraine resulted significantly higher among nurses with shift work disorders, that is, difficulties in sleeping or experiencing excessive sleepiness related to work schedule. These findings suggest that workers who do not cope well with shift work are at increased risk of other health complaints like migraine. This aspect should be deeply investigated when assessing the relationship between night shift works and migraine occurrence.

Furthermore, it is well known that shift-work schemes may differently affect the sleep of workers according to the number of hours worked per day, the number of off-days between two shifts, and the occurrence of consecutive night shifts.[33] In Portela et al,[33] nurses who had a peculiar working schedule with no consecutive night-work schemes, characterized by 12 h shift, followed by 2 days-off, showed no differences in sleep complaints compared to day workers with a lower prevalence in the night worker group. It may be that the larger number of off-days is beneficial to night shift workers in regard to the quality of sleep, therefore reducing expected differences with day workers. This may also explain why the number of night shifts was positively associated with the prevalence of migraine in Wang et al.[36] Unfortunately, most of the studies did not specifically addressed the prevalence of migraine among peculiar working schedule, that is, fixed evening workers or employees with irregular working hours explicitly without night shifts. The results obtained by Jakobsen et al[38] regarding the increased risk of treatment-seeking migraine in evening work may be related to the greater psychological stressors they may experience during this type of schedule, that is, high cognitive demands, low decision authority, low skill discretion and conflicts at work as reported by Bøggild et al.[49] Yet, other explanations for these findings may be that migraine is harder to tolerate or that it is easier to find time to seek treatment when working evening shifts. Overall, this underlines the importance to currently focus occupational health research on ergonomic shift scheduling, that is, rotating shifts, short periods of evening shifts, as well as the inclusion of at least two free evenings between Monday and Friday in every week, that may better protect the health of exposed workers, particularly of those with conditions of migraine hypersusceptibility also avoiding disturbances of social life.[50,51]

To this aim, it may be important to address both modifiable and non-modifiable risk factors that can promote disease onset and progression, as well as the transition from episodic to chronic migraine. These risk factors may include age, gender, socioeconomic status, obesity, tobacco, and/or alcohol addiction, stressful life events, depression, overuse of acute medications, ineffective treatments, and possibly caffeine use.[52] In this scenario, sleep disorders may function increasing risk for transitioning from episodic to chronic

migraine, and these should be taken in deep consideration when evaluating patients/workers with migraine.[53-55] From an occupational medicine perspective, it seems important to define suitable health promotion strategies to favor healthy lifestyles and to contrast the above-mentioned migraine risk factors to support shift/night shift workers in tolerating such occupational organization according to a "global health" approach and possibly avoiding migraine manifestation. On the other side, it may be important to adopt workplace preventive measures for migraine patients and consider the opportunity for more severe, chronic migraineurs, to modify work schedules that should be periodically re-assessed according to the migraine course and its transition to more or less disabling patterns.[40]

Overall, some limitations of the review need to be considered for a suitable interpretation of the results. The low number of reviewed studies and the not homogeneous methodological approaches adopted, in terms of analyzed outcomes (ie, migraine prevalence, incidence or risk), heterogeneous populations investigated (ie, national working populations, healthcare workers, nurses), and different sample size prevent a suitable comparison of the obtained findings. This allowed to extrapolate main research-oriented considerations about experimental design inconsistency, quality of the reviewed studies and research gaps suitable for further investigation, more than definite conclusions on the relationship between shift work-migraine relationship.

In conclusion, future studies should address the relationship between migraine occurrence and shift work considering the diagnosis of the disease in a more homogeneous manner, assessing the severity of migraine, scales of stress, characteristics of shift works, levels of workload, patterns of sleep, seniority of employment in specific working schedule, or other lifestyle and socioeconomic characteristics. This may have important implications in occupational settings to set up risk assessment and management strategies to protect the health of susceptible and/or migraine affected workers.

DISCLOSURE

Approval of the research protocol: N/A. *Informed consent:* N/A. *Registry and the registration no. of the study/trial:* N/A. *Animal studies:* N/A. *Conflict of interest:* Authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

VL conceived the study, wrote and edited the manuscript; PG, MCM, SM reviewed the literature and wrote the manuscript; MLE edited the manuscript; II wrote, edited, and provided overall guidance to the development of the manuscript. All authors read and approved the final manuscript.

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How to cite this article: Leso V, Gervetti P, Mauro S, Macrini MC, Ercolano ML, Iavicoli I. Shift work and migraine: A systematic review. *J Occup Health*. 2020;62:e12116. https://doi.org/10.1002/1348-9585.12116