The occurrence of the shift work disorder (SWD) in health-care workers (HCWs) employed in 24/7 hospital wards is a major concern throughout the world. In accordance with literature, SWD is the most frequent work-related disturb in HCWs working on shift schedules including night shift. In agreement with the Luxembourg Declaration on workplace health promotion (WHP) in the European Union, a WHP program has been developed in a large Hospital, involving both individual-oriented and organizational-oriented measures, with the aim to prevent the occurrence of SWD in nurses working on shifts including night shift. The objective assessment of rotating shift work risk and the excessive sleepiness were detected before and after the implementation of the WHP program, by using the Rotating Shiftwork-questionnaire and the Epworth Sleepiness Scale. The findings of this study showed the effectiveness of the implemented WHP program in minimizing the impact of shift work on workers’ health and in preventing the misalignment between sleep-wake rhythm and shift working.

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morning before the night shift (Table 2). The individual-oriented measures consisted in workers on adoption of the following measures (Table 3):

- Training shift workers in adopting effective safety strategies to manage and predictability of shift work, high speed of shift rotation, one risk in HCWs. In particular, we highlighted the need of regularity and predictability of shifts, including night shift. With regard to the scheduling, in accordance with the shiftwork model and the strategic role of ergonomic scheduling in preventing the impact of shift work on workers’ well-being, through the improvement of work–life balance.

Table 1
Sample demographics

| Nurses | N. |
|--------|----|
| Entire group | 475 |
| Female | 281 |

| Age range (years) | Females N (%) | Males N (%) |
|-------------------|---------------|-------------|
| <35               | 27 (9.6)      | 19 (9.8)    |
| 36-40             | 31 (11.0)     | 21 (10.8)   |
| 41-45             | 36 (12.8)     | 28 (14.4)   |
| 46-50             | 65 (23.1)     | 46 (23.7)   |
| 51-55             | 61 (21.6)     | 43 (22.2)   |
| 56-60             | 39 (13.8)     | 24 (12.4)   |
| 61-65             | 23 (8.1)      | 11 (5.7)    |
| >65               | 0 (0.0)       | 2 (1.0)     |

| Years of shiftwork | Females N (%) | Males N (%) |
|--------------------|---------------|-------------|
| <5                 | 11 (3.9)      | 4 (2.0)     |
| 5-10               | 14 (5.0)      | 11 (5.7)    |
| 11-15              | 36 (12.8)     | 12 (6.3)    |
| 16-20              | 57 (20.3)     | 35 (18.3)   |
| 21-25              | 71 (25.3)     | 58 (29.9)   |
| 26-30              | 65 (23.1)     | 51 (27.4)   |
| >31                | 27 (9.6)      | 20 (10.4)   |

| Smoking habit | Females N (%) | Males N (%) |
|---------------|---------------|-------------|
| Age range (years) | Females N (%) | Males N (%) |
| <35           | 54 (19.2)     | 41 (21.1)   |
| 35-50         | 19 (35.2)     | 15 (36.6)   |
| >50           | 18 (33.3)     | 14 (34.1)   |

| Alcohol consumption | Females N (%) | Males N (%) |
|---------------------|---------------|-------------|
| Age range (years)   | Females N (%) | Males N (%) |
| <35                 | 61 (21.7)     | 51 (26.3)   |
| 35-50               | 18 (29.3)     | 19 (37.3)   |
| >50                 | 21 (34.4)     | 15 (29.4)   |

2.1. Organizational and individual-level interventions

Although to date no strong conclusions exist about the strategies for shift workers to deal with the effects of shift work, we followed the best evidence from trials and international recommendations [15]. A balanced approach was adopted, combining the strategy of risk reduction with the strategy of the development of protective factors and health potentials, involving the organizational level of the company (head physicians and head nurses) and the HCWs exposed to shift work, including night shift. With regard to the organizational level interventions, the company management was trained to implement ergonomic work schedules, following the recommendations by the Health and Safety Executive [16] jointly with the findings of the recent literature on shift work risk in HCWs. In particular, we highlighted the need of regularity and predictability of shift work, high speed of shift rotation, one free weekend in the month at least, forward rotating schedules, rest periods between consecutive shifts (>11 hours), one rest day after a night shift. Moreover, we suggested an organizational model in which the shift schedules were designed with thirty days in advance, to ensure the regularity of shiftwork model and the flexibility of shiftwork schedules through the worker’s participation to the whole process of designing and implementing the schedules. In accordance with literature, the regularity and preventability of shifts represent protective factors in minimizing the impact of shift work on workers’ wellness, through the improvement of work–life balance. The implemented shift scheduling provided for a morning start after 7 a.m., with the aim to avoid the interference of shift work with sleep regularity due to early morning awakenings; in fact many studies showed that early morning start has a detrimental effect on restful sleep due to the shorter rem phase in the last sleep period, interrupted by early awakening. The training of workers and company management on issues related to shift working and on the strategic role of ergonomic scheduling in preventing the impact of shift work on workers’ health and safety, lead to reach the goal of the involvement of the entire health-care organization in addressing the concern, in agreement with a participatory approach to shiftwork risk management; the aim of the training was also to promote suitable lifestyles among workers to counteract the interference of shiftwork on circadian rhythms; in particular, workers were informed about healthy behaviors to be adopted during the night shift, and the days before and after the night shift, concerning not only the management of sleep

3. Results

Four hundred seventy-five ESS questionnaires were received, and the response rate was 91.7%. The excessive sleepiness measured by ESS resulted significantly higher before than after the adoption of the WHP program (11.1 ± 2.3 vs. 7.4 ± 1.9; p < 0.05) (Table 4). The objective assessment of the shift work risk showed a significant reduction of the level of risk in all the detected wards, after the implementation of the WHP; compared to the period before such intervention cumulative score after intervention = 23.5 ± 2.3; p < 0.05 (Table 4). The significant reduction of both shift work risk and excessive sleepiness was confirmed after controlling for demographic variables (gender, age, years of shift work, smoking habit, and alcohol consumption).

4. Discussion

The findings of this study showed the effectiveness of the ergonomic scheduling together with individual-oriented measures in minimizing the impact of shift work on workers’ health and in preventing the misalignment between sleep-wake rhythm and shift working. With regard to the scheduling, in accordance with literature, we implemented a fast forward rotating shift as more protective than other scheduling (i.e. slow or intermediate rotating shifts, back-rotating scheduling), rest periods between consecutive shifts (>11 hours), a rest day after a night shift. Moreover, we suggested an organizational model in which the shift schedules were designed with thirty days in advance, to ensure the regularity of shiftwork model and the flexibility of shiftwork schedules through the worker’s participation to the whole process of designing and implementing the schedules. In accordance with literature, the regularity and preventability of shifts represent protective factors in minimizing the impact of shift work on workers’ wellness, through the improvement of work–life balance. The implemented shift scheduling provided for a morning start after 7 a.m., with the aim to avoid the interference of shift work with sleep regularity due to early morning awakenings; in fact many studies showed that early morning start has a detrimental effect on restful sleep due to the shorter rem phase in the last sleep period, interrupted by early awakening. The training of workers and company management on issues related to shift working and on the strategic role of ergonomic scheduling in preventing the impact of shift work on workers’ health and safety, lead to reach the goal of the involvement of the entire health-care organization in addressing the concern, in agreement with a participatory approach to shiftwork risk management; the aim of the training was also to promote suitable lifestyles among workers to counteract the interference of shiftwork on circadian rhythms; in particular, workers were informed about healthy behaviors to be adopted during the night shift, and the days before and after the night shift, concerning not only the management of sleep

| Table 4
| Reduction of shift work risk and excessive sleepiness before and after the adoption of the WHP program | cumulative score before intervention | cumulative score after intervention | p-value |
|-----------------------------------------------|------------------------------------|-----------------------------------|---------|
| Four hundred seventy-five ESS questionnaires were received | 11.1 ± 2.3 | 7.4 ± 1.9 | <0.05 |

Perhaps taking advantage of the “circadian dip” between 2 and 6 pm, to help initiate daytime sleep.

During the night shift: keeping shift naps to less than 30 minutes, to avoid slow wave sleep followed by grogginess on waking, known as “sleep inertia”; assumption of caffeine before napping but making that the last caffeine of the night; eating just enough to remain comfortable during the shift; avoid caffeine and nicotine in the last few hours of the shift.

After the night shift: attempting 90 or 180-minute nap immediately following the shift; going outside after waking; going to bed close to the normal time. In the next days: avoiding daytime napping.

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deprivation, but also the appropriate diet and physical activity, recommended to ensure realignment of circadian rhythms, including the sleep–wake rhythm, in shift workers. Shift workers and management staff have become aware of the criteria to minimize shiftwork risk through organizational and individual-level interventions, and, therefore, to prevent SWD, with the aim not only to improve worker safety, but also to improve the quality of health services. In fact, by literature, in healthcare sector the SWD due to shift work has been associated with decreased productivity, high prevalence of medication errors, other than increased absenteeism, impaired safety, diminished quality of life, and adverse effects on health of shift-HCWs. Gómez-Garcia et al. [17] revealed that SWD is related to nurses’ concern for low performances at work; in fact shift-nurses felt both a negative quality of their job and an unwholesome work environment because sleep deprivation had detrimental effect on nurses’ skill to ensure the high level of care to their patients and they perceived their work more unhealthy, difficult, and dangerous; moreover shift-nurses had negative perceptions of managers’ skills regarding team working, coaching and leadership, and felt lack of support from supervisory staff; based on these findings, the authors demonstrated that the prevention of sleep deprivation in shift-nurses was essential to guarantee nurses’ abilities to provide the high standard of care they want to give to their patients and, consequently, to avoid a significant number of adverse effects.

In this study the WHP focused on SWD prevention revealed a strategic way to minimize the impact of shift work on workers’ health and wellness; health-care organizations should consider the adoption of WHP programs focused on both individual and environmental oriented measures to prevent the SWD and to enhance health-promoting potentials and well-being in the workforce. In this study the safety policy oriented to the active involvement of both management staff and workers in achieving safety objectives has replaced the concept of a rigidly hierarchical organization and, therefore, workers’ safety has been considered the result of the participation and collaboration of all company subjects. In accordance with the new approach, the implementation of an integrated safety system represents the strength for promoting workers’ protection from occupational risks, including shift work.

5. Limitations

This study suffers from some limitations; first, this research is one group pretest–post-test study; pre-experimental design of the present research limits the possibility of drawing conclusions, therefore, caution should be taken in generalizing the findings. Moreover, the findings could have been influenced by organizational factors intrinsic to the Italian occupational context and, consequently, not be true for all hospital departments. Finally, the study did not consider the nurses’ chronotype (morningness or eveningness oriented chronotype) in the analysis of SWD.

### Conflicts of interest

All contributing authors declare no conflicts of interest.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.shaw.2020.03.007.
References

[1] Caruso CC. Negative impacts of shiftwork and long work hours. Rehabil Nurs 2014;39:16–25.
[2] Fathi A, Hajizadeh M, Moradi K, et al. Medication errors among nurses in teaching hospitals in the west of Iran: what we need to know about prevalence, types, and barriers to reporting. Epidemiol Health 2017;39:e2017022.
[3] Ferrer P, Guadi M, Marcheselli L, et al. The impact of shift work on the psychological and physical health of nurses in a general hospital: a comparison between rotating night shifts and day shifts. Risk Manag Health Policy 2016;9:203–11.
[4] American Psychiatric Association. Sleep-wake disorders. Available online at: http://www.dsm5.org/proposedrevision/Pages/Sleep-WakeDisorders.aspx (last accessed 04-27-2020).
[5] Huang Li-Bi, Tsai MC, Chen CY, et al. The effectiveness of light/dark exposure to treat insomnia in female nurses undertaking shift work during the evening/night shift. J Clin Sleep Med 2013;9:641–6.
[6] d’Ettorre G, Pellicani V, Greco M, Mazzotta M, Vullo A. Assessing and managing the shift work disorder in healthcare workers. Med Lav 2018;109(2):144–50.
[7] Flo E, Pallesen S, Moen BE, et al. Short rest periods between work shifts predict sleep and health problems in nurses at 1-year follow-up. Occup Environ Med 2014;71:555–61.
[8] Dijk DJ, Groeger JA, Stanley N, Deacon S. Age-related reduction in daytime sleep propensity and nocturnal slow wave sleep. Sleep 2010;33:211–23.
[9] Chang YS, Wu YH, Chen HL, Hsu CY. Is one day off sufficient for re-adaptation to a daytime routine after two consecutive nights of work? Ergonomics 2017;31:1–7.
[10] Waage S, Pallesen S, Moen BE, et al. Predictors of shift work disorder among nurses: a longitudinal study. Sleep Med 2014;15:1449–55.
[11] Øyane N, Pallesen S, Moen BE, et al. Associations between night work and anxiety, depression, insomnia, sleepiness and fatigue in a sample of Norwegian nurses. PLoS One 2013;8:e70228.
[12] European Network Workplace Health Promotion. Luxembourg declaration on workplace health promotion in the European Union. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin; 1997.
[13] d’Ettorre G, Vullo A, Pellicani V, Ceccarelli G. Preliminary assessment of rotating shiftwork risk in a twenty-four hours hospital department. Annali di Igiene 2018;30:297–306.
[14] Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep 1991;14:540–5 [PubMed: 1798888].
[15] McKenna H, Wilkes M. Optimising sleep for night shifts. BMJ 2018;360:j5637.
[16] Health, Executive Safety. Managing shiftwork: health and safety guidance. London: HSE. 2006. Available on: www.hse.gov.uk/pubns/books/hsg256.htm. [Accessed 29 September 2019].
[17] Gómez-García T, Ruzafa-Martínez M, Fuentelsaz-Gallego C, et al. Nurses’ sleep quality, work environment and quality of care in the Spanish National Health System: observational study among different shifts. BMJ Open 2016;6: e012073.