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Combining Virtual Reality with Horticulture Therapy for Shift Work Disorder among Healthcare Security Personnel

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ABSTRACT

Background: Therapeutic horticulture (TH), as an adjuvant for mental health, attracts health care specialists to evidence-based therapy approaches. However, the effectiveness of plants as elicitors and in improving patient outcomes is still uncertain in practice. Hence, the study was conducted to evaluate the feasibility of different therapeutic approaches for shift work disorder amongst securities with poor sleep quality.

Methods: Sixty securities working in night shifts were selected for the study and 30 participants were assigned to the intervention group and 30 to the control group through pre-test post-test control design. The intervention and the control groups were tested for the Perceived Stress Scale (PSS), the Inclusion of nature self scale (INS), the Pittsburg Sleep Quality Index (PSQI), Physical (blood pressure, heart rate), personal and psychological well-being. The horticulture interventions through combination of virtual reality, gardening, potpourri making, chamomile tea intake, aromatherapy and pot painting were provided for the experimental group.

Result: The therapy has brought fascinating results in decreasing stress, improving the sleep and better well being of the subjects. The pre-test value for the Pittsburg sleep quality index indicated a sleep deprivation score of 13.27±2.38 during the pre-test and it has improved the sleep level with a post-test value of 6.10±2.23. The drop in blood pressure for the systolic/diastolic blood pressure from 138.30±21.02/85.13±12.59 (Pre-test) to 127.93±14.80/81.90±11.07 (Post-test) has been a good sign of therapeutic approaches at $p<0.001$. The values are also significant for personal and psychological well being and the subjective feedback results shows, among the therapies the virtual reality garden viewing followed by potpourri and pot painting showed higher rankings. Therapeutic horticulture being benign and non-threatening will undoubtedly expand and can take upon as one of the sustainable approaches in kindling the senses and improving daytime sleep for night shift workers.

Key words: Aromatic oil, Chamomile, Shift work disorder, Sleep deprivation, Therapeutic horticulture, Virtual reality, Well being.

Abbreviations: HR: Heart rate, HT: Horticulture therapy, PSQI: Pittsburgh sleep quality index, PSS: Perceived stress scale, VR: Virtual reality, WHO: World health organization.

INTRODUCTION

Terming “graveyard shift” in the 18th century considering the eerie stillness of the night and dimly lit hospitals mostly the healthcare sectors predominantly work during the night time. The current research works on securities in healthcare sectors whose job location is mostly exposed to outdoor environments and working night shifts. The India times states that working against the natural body clock the security personnel encounter compounding effect of health issues which requires immediate attention (Anujha Jaisal, 2024). The complicated work nature of the security personnel working at night settings where visibility is profoundly low makes them exceptionally vigilant and anxious as stated by the Great Britain statistics in 2020. The irregular work hours seclude them from their families and isolate them causing loneliness and depression besides disrupting their sleep pattern leading to shift work disorder and fatigue impacting mental health (Lee, 2024). Globally heightened non communicable disease occurrence like diabetes, cardiovascular diseases and chronic inflammatory conditions affecting public health (Bajaj and Sharma, 2024) is observed and the night workers

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facing shift work disorder will be prone to it easily due to their irregular eating habits working at irregular hours.

Horticulture therapy a form of complementary and alternative medicine that offers clients remedial (Son *et al.,* 2016) through a trained therapist involves plants and horticulture making them distinguishable. Comprehensive pieces of literature have proven that nature-based programs through gardening have cured many mental health-related problems and are recognized as a multi-component approach that has affected a broad range of health and well-being outcomes (Paniru *et al.,* 2024). Chamomiles, lemon balm, theanine, Valerian, St. Johns wort, Rhodiola are some of the horticultural herbal plants used as nervine stimulants to act on the nervous system for sleep promotion as recommended by the US department of veteran affairs (Minichiello, 2023). Traditional Indian medicine relies on a wide range of herbs and is called a "living tradition" in India because of their diverse pharmacological qualities and its bioactive phytomedicines making them therapeutic to treat various ailments (Murugan *et al.,* 2021). The horticulture therapy involving plants and gardening needs to extend its hand to modern tools like virtual reality instruments which could aid participants who could not be approached for interventions at specific sites or at particular times. Blending virtual reality tools (Kim *et al.,* 2019) with therapeutic horticulture in the current scenario can be used for specific participants who may be allergic to odor, pollens, age concerns and other safety issues like collisions and falls (Lin *et al.,* 2020).

Being facing stressful situations on daily basis leads to stress and anxiety and these personnel's need to find good ways to rest their mind and relax after work. One such good way is plant-based therapies and it is the role of managers, chief officers and companies to understand the challenges faced by them and provide support measures that are complementary and palliative. The research findings will provide a solution for considering the unnoticed populations in health care sectors where the securities were vulnerable to physical and mental health issues being prone to long working hours, exposure to unprecedented weather, continuous alertness and continuous standing.

MATERIALS AND METHODS

Experimental design and site

The quantitative approach through static pre-test and post-test design (Fig 1) was selected where the experimental group is provided intervention and the control group lacks the intervention. The advantage of having a control group

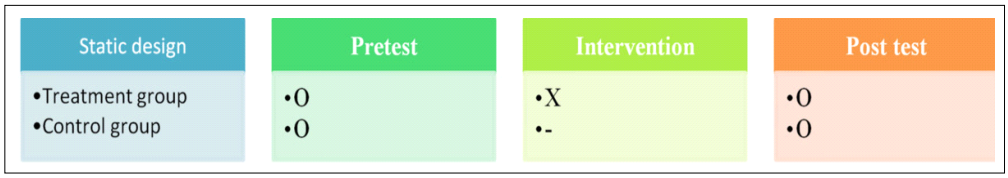


Fig 1: Static pre-test and post-test design used for the study.

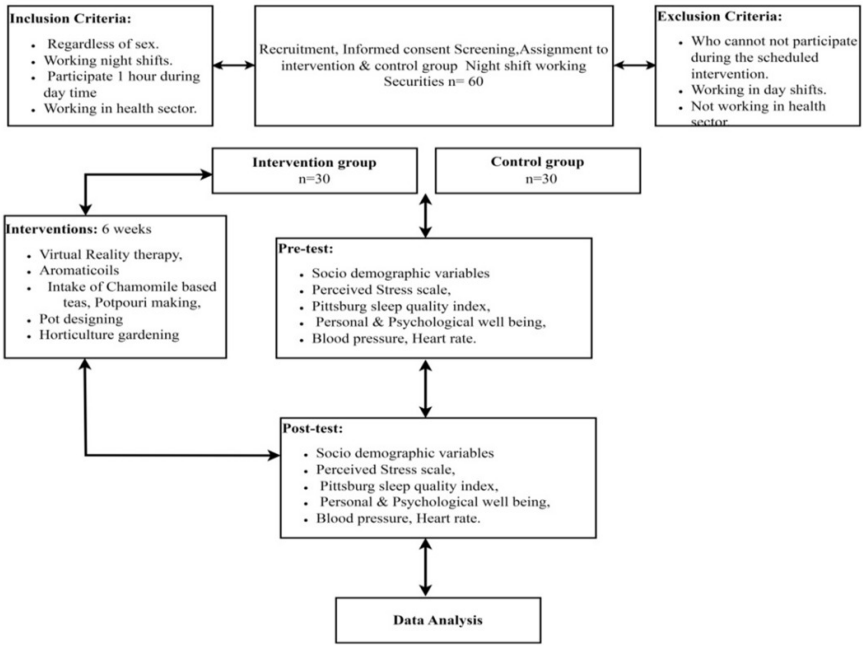


Fig 2: Flow chart on Horticulture therapy program for the security personnel's suffering from shift work disorder.

helps to estimate the casual impact of intervention and avoids threats on selection bias, attrition and regression to mean and both groups are comparable at the baseline. The virtual reality therapy and the garden therapy were conducted at the urban farm center (UFC), SRM Institute of Science and Technology in Chengalpattu, Tamil Nadu, India which has a diverse landscape environment providing scope for the therapy and the research was conducted from 2022 to 2024. Non-probability purposive sampling technique was used for the study (Fig 2) with 30 individuals working in the night shifts who satisfied the sampling criteria were included in the study as an experimental group and 30 individuals working in night shifts is considered as control.

Research tools and techniques

The scales used in the study are the standard research tools and earlier literature have advocated the tools used as having adequate internal consistency, test-retest reliability and validity across different populations. The questioners used for the study include the perceived stress scale (10-item scale) developed by Cohen *et al.* in 1983, pittsburgh sleep quality index (PSQI) a self-rated questionnaire by Buysee *et al.,* 1989, Personal Well-being index scale (PWI) developed by International well-being group in 2013 endorsed by WHO and the 18-item version Psychological Well-Being Scale (Ryff and Keyes, 1995) followed by the subjective feedback on therapeutic interventions that includes a five-point Likert scale for satisfaction. The PSQI tool used is a valid tool used across globally by researchers on sleep issues studies and the minor limitation of the tool is, the psychometric properties may vary across different populations and it is a self reported tool. The research tools used include the VR, BP monitor, essential oil and tea bags. The features of the Virtual reality equipment include the Meta Quest 3 headset featuring updated hardware with the elements of Quest Pro. The blood pressure and heart rate were monitored through Dr. Morepen bp 02 which is clinically tested and often used in research for its accuracy and friendliness. The lavender-based essential oil was obtained along with potpourris and reeds as carriers for elevating sleep. The standard Chamomile-based teas bags were obtained and provided to the participants. Fig 3 explains the interventions provided to the security guards.

Statistical analysis

Data's were collected by contacting the Head of security to understand the shift work assignment and the number of securities working in the health care sector. The acquired data was analyzed using descriptive and inferential statistics. The impact of horticulture therapy was tested for stress and sleep in securities using Paired t-test (inferential statistics).

RESULTS AND DISCUSSION

The factors related to shift work amongst the security guards is presented in Table 1. The question regarding the number of night shifts per week states nearly 41.6% work more than five night shifts, while 45% of the population works three to five-night shifts. Working continuous night shifts affected their ability to sleep (51.7%) and 61.6% claimed working night shifts had an impact on the day and 55% of the securities answered that they were dissatisfied with working in night shifts. The questions regarding income depict that 33.3% were satisfied that they receive some mere additional money than day shifts, while 51.7% were not happy with the income they receive. 65% of the securities preferred to work day shifts and 50% per cent thought that it frequently caused stress. The securities felt bad (40%) about not spending quality time with their family, while 36.7 per cent said they were fine with it. The results of the factors related to night shift work have issues to be addressed regarding the implications of well-being at the workplace, *i.e.*, in the 24 hour work cycle the maximum of time spent by a security officer in the health sector is around

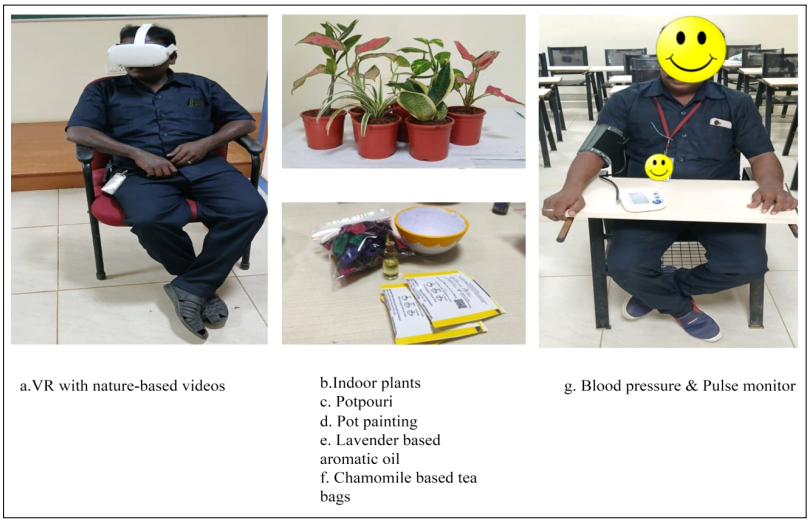


Fig 3: Combination of Virtual reality and different Horticulture therapy as intervention along with blood pressure and pulse rate checking before and after interventions.

10-12 long hours per day and the employers expect that the well being should be carried out only during their resting periods or after hours as the health sector work nature demands it. With 51.7% of the population expressed dissatisfaction on their income the solution and cure for their sleep medications should be less and thus utilization of the natural methods will cut the costs and being accessible to the common man and the less earner (Niwas *et al.,* 2024).

The physiological scores for the blood pressure and pulse rate were recorded before the intervention and also taken after two months of the intervention period and presented in Table 2. The blood pressure results for the treatment group has a pre-test value of 138.30±21.02 and after the intervention period it has decreased to 127.93±14.80 with a mean difference of 10.36±10.04, for the Diastolic and for the systolic pressure the values are 85.13±12.59 for the pre-test period and 81.90±11.07 during the post-test period with a mean difference of 3.23±3.97 and both the values are significant at 1% interval. The heart rate during the pre-test period is 79.16±18.67 and it has decreased to 77.76±15.25 after intervention with a difference 0f 1.45.30 with 1% significance. As the security personnel involved for this research was in the health sector and the amount of anxiousness and depression is tagged with job nature as they have to be vigilant all the time to avoid any error concerning other life and the results over the control group states that the therapy has created a way of relaxation, calmness (Xiayoi *et al.,* 2024) and thus reducing the blood pressure and heart rate.

The scores for the perceived stress scale have a value of 23.03±3.69 which has been reduced to 17.10±4.38 after intervention with 5.93±5.22 and the score boards of the control group is also presented in Table 3. Working in a night shift-facing environment kept them anxious and stressed and working in gardening activities for two months have decreased the stress level, thus the PSS scores have a good reduction score. Exposing the securities to nature scenes through VR had mediated the negative mood states and brought in positive emotions (Berto, 2014) and reduced their stress (Felix *et al.,* 2019).

Table 1: Factors related to night shift working among the health care security personnels.

Studied characteristics	Total n=60	Intervention group n=30	Control group n=30
No. of night shifts per week			
< 2	8(13.4%)	2(6.7%)	6(20%)
3-5	27(45%)	15(50%)	12(40%)
> 5	25(41.6%)	13(43.3%)	12(40%)
Impact of night shift work on sleep			
Affects	31(51.7%)	12(40%)	19(63.3%)
No effects	13 21.6%)	7(23.3%)	6(20%)
General	16(26.7%)	11(36.7%)	5(16.7%)
Impact of night shift work on Day			
Affects	37(61.6%)	18(60%)	19(63.3%)
No effects	12(20%)	6(20%)	6(20%)
General	11(18.4%)	6(20%)	5(16.7%)
Satisfaction with night shift works			
Satisfied	13(21.6%)	5(16.7%)	8(26.7%)
Dissatisfied	33(55%)	20(66.7%)	13(43.3%)
General	14(23.4%)	5(16.7%)	9(30%)
Satisfaction with night shift work income			
Satisfied	20(33.3%)	8(26.7%)	12(40%)
Dissatisfied	31(51.7%)	18(60%)	13(43.3%)
General	9(15%)	4(13.3%)	5(6.7%)
Does working in night shifts create stress?			
Often	30(50%)	18(60%)	12(40%)
Very often	21(35%)	10(33.3%)	11(36.7%)
No	9(15%)	2(6.7%)	7(23.3%)
Do you prefer working in night or day shift?			
Day	39(65%)	18(60%)	21(70%)
Night	21(35%)	12(40%)	9(30%)
Rate the quality time spent with your family			
Good	14(23.3%)	8(26.7%)	6(20%)
Bad	24(40%)	18(60%)	6(20%)
Okay	22(36.7%)	4(13.3%)	18(60%)

The personal well being scores has a good improvement with value increasing from 32.86±9.30 to 51.60±9.35 with a difference of 18.73±8.32 and the t value is 11.32 and significant at 1%. The thought of sharing time, being noticed and having interactions with them specifically has made them feel better personally and mentally as the scores of personal and psychological well-being has improved and this is one of the best therapeutic approaches of gardening.

The psychological well being scores have good improvement during the post-test with a score of 80.83±9.69 from 74.60±9.33 with a difference of 6.23±5.41 which is significant at 1%. All the scores were compared with a control group and presented in Table 2. The psychological problem concerning stress, anxiety and depression are global public health issues accompanied with sleep issues (Wainberg *et al.,* 2017) and the research has produced positive outcomes.

Table 3 values for the effect of horticulture interventions over sleep improvement, with lower the value higher the sleep improvement indicating a score of 6.10±2.23 from 13.27±2.38 with a difference of 7.17±1.90. In the seven components, the values are not significant for sleep duration and sleep medication and habitual sleep efficiency. The core aspect the research focused was on sleep improvement and the influence of aromatic oils with lavender base and chamomile teas for sleep improvement in combination have got better results over the sleep schedule and we could see the PSQI scores have improved after the interventions were provided. The Lavandula species possess a significant therapeutic potential due to the presence of a variety of bioactive compounds, such as linalool and retinol, which are utilized in a variety of pharmaceutical applications. Consequently, it is imperative that additional research be conducted to explore the potential of these multi-therapeutic active compounds (Mohamed *et al.,* 2024).

The results of the subjective feedback on the different horticulture interventions after treatment collected from the security personnel's are depicted in Fig 4. The feedbacks for the VR therapy is highest among all the horticulture interventions with 43% scoring followed by pot painting and potpourri making with each 37% in completely satisfied category. Among the therapies the VR was found to be a fascinating technology liked by the security as it immersed them into a different world reliving the depression and stress. The VR though synthetic, given them the experience of being in the existing world and makes them incarnated making their body feel they are in the virtual world (Riva *et al.,* 2016) and it makes them forget their worries and gives a sense of being in another physical environment forgetting their physical in their real world. Though VR has been used to reduce stress (Naylor *et al.,* 2019) its application through a combination of various therapies at work place settings is still unexplored and there is a gap in literature of using these technologies in workplace. The potpouris are colourful and made out of dry flowers which are everlasting, eco-friendly and biodegradable which can be treasured for years and an attractive charm for the employee (Pooja *et al.,* 2023). The pot paintings are interesting income generating hobbies and as most of securities are in senior category these potting up plants heals geriatric problems and focus on multisensory experience engaging all senses (Steffi and Sreedaya, 2024).

Table 2: Comparison of therapeutic outcomes of the treatment and control group for physiological and psychological scores using paired t-test.

Measures	Pre-test	Post-test	Difference	T	P
Blood pressure-diastolic					
Treatment	138.30±21.02	127.93±14.80	10.36±10.04	4.57	<0.01
Control	133.80±13.95	134.76±14.86	-0.96±9.1		
Systolic					
Treatment	85.13±12.59	81.90±11.07	3.23±3.97	6.30	<0.01
Control	91.30±7.40	93.90± 7.40	-2.6±3.1		
Heart rate					
Treatment	79.16±18.67	77.76±15.25	1.4±5.30	3.26	<0.01
Control	85.80±12.55	88.16±12.49	-2.36±3.30		
Perceived stress scale					
Treatment	23.03±3.69	17.10±4.38	5.93±5.22	5.31	<0.01
Control	20.80±4.14	20.43±4.18	0.36±2.35		
Personal well being					
Treatment	32.86±9.30	51.60±9.35	18.73±8.32	11.32	<0.01
Control	48.03±20.08	46.20±17.89	-1.83±5.43		
Psychological well being					
Treatment	74.60±9.33	80.83±9.69	6.23±5.41	5.31	<0.01
Control	71.53±7.62	69.06±7.58	-2.46±2.04		

< 0.01 is significant at 1%.

Table 3: The effect of Horticulture interventions on the 7 Pittsburg sleep quality index using paired t test.

	Pre-test	Post-test	Gain score	T	P
Sleep quality					
Treatment	1.93±0.82	0.83±0.79	1.1±0.71	1.67	< 0.01
Control	1.73±0.86	2.00±1.17	-0.26±0.82		
Sleep latency					
Treatment	1.97±0.76	0.83±0.59	1.13±0.57	6.71	< 0.01
Control	1.73±0.69	1.93±1.08	-0.20±0.92		
Sleep duration					
Treatment	1.83±0.65	0.90±0.66	0.93±0.64	-1.46	0.07*
Control	2.10±0.71	0.90±0.55	1.20±0.76		
Habitual sleep efficiency					
Treatment	1.56±0.89	0.73±0.69	0.83±0.74	0.52	0.30*
Control	1.83±0.87	1.10±0.75	0.73±0.74		
Sleep distribution					
Treatment	2.20±0.71	0.83±0.83	1.37±1.00	3.51	<0.01
Control	2.13±0.86	1.50±0.94	0.63±0.56		
Use of sleeping medication					
Treatment	1.80±0.71	0.93±0.74	0.87±0.57	1.49	0.06*
Control	1.77±0.82	1.20±0.96	0.57±0.94		
Daytime dysfunction					
Treatment	1.97±0.72	1.03±0.67	0.93±0.37	4.35	<0.01
Control	2.03±0.81	1.83±0.95	0.20±0.85		
Total PSQI					
Treatment	13.27±2.38	6.10±2.23	7.17±1.90	7.09	<0.01
Control	13.33±2.80	10.47±3.39	2.87±2.73		

* Not significant, < 0.01 is highly significant.

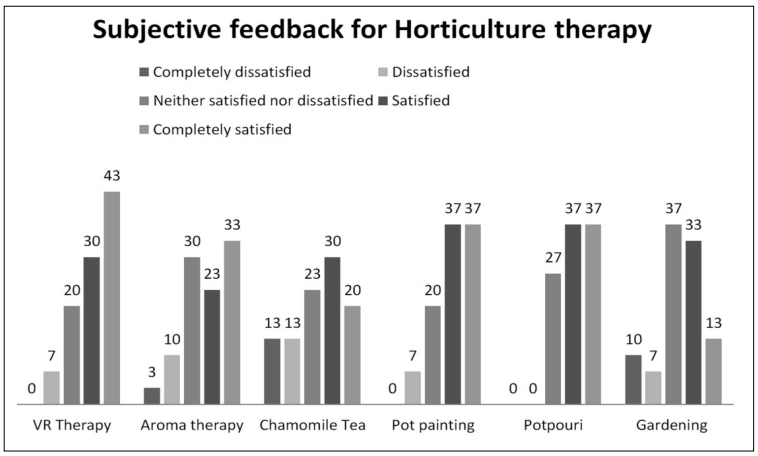


Fig 4: Feedback scores on various horticulture therapy interventions.

The approach of a combination of VR technology and different horticulture interventions as therapy had significant physiological and psychological effects on the security over shift work and sleep issues (Hernandez *et al.,* 2022). The therapies to be effective among the securities should be cost-effective, approachable, popular, non-arousing nature scenes (Pizzoli *et al.,* 2019), providing quality immersive experiences (Huygelier *et al.,* 2019) and at the same time the therapy should improve the overall sleep (Gonazole and Kirkevold, 2014) and these were achieved through the combination of VR and HT.

The significance of the study is the research worked on the influence of horticulture therapy addressing the shift work disorder has accessed the under noticed working personnel's in the working community who were prone to severe threats physically and mentally. Further no studies have concentrated on considering the securities as sample for the research, though they are the integral workforce in

maintaining the orderlies in the health sector avoiding chaos. Hence the aim of the study addressed the sleep disorder among the securities through a combination of virtual reality and other HT bringing in sleep improvement and wellbeing. The limitations includes as most of the horticulture studies are nature (Boersma *et al.,* 2023) based and controlled by environmental factors, to have effective interventions the study population cannot concentrate on more than 30 numbers per horticulture therapist. As being in the racing society especially in the field of health sector we cannot neglect working in night shifts hence care must be taken as to improvise the sleep through stress reliving activities like VR and sleep-promoting therapies through horticulture which should be made available to the night shift workers by providing plenty of relaxing time to recover from sleep issues. The shift work disorders are combination of various morbidities and hence cannot be cured with single interventions and a combination of various horticulture therapies with technology will thus drive away the multiple factors and thus making the research stand unique. The research findings hence will guarantee that the future horticulture therapy should focus and work together with different therapeutic approaches and having in mind that the core concept of horticulture therapy is nature based interventions.

CONCLUSION

The health and safety executive states that in 2020 around 51% of illness was due to work related stress and 17.9 million working days were lost. Thus the study concentrated on the sustainable solutions for meeting out the wellbeing of the working community, specifically the horticulture therapies were effective in alle*via*ting the stress among the night workers with higher stress issues. The VR technology has given them a sense of living along with the technologically driven world and the satisfactory levels were too good for the VR. In conclusion the combination of VR, aromatic oils, sleep inducing tea bags, visually attractive indoor plants and gardening activities have reduced the stress and improved the well-being and issues regarding shift work.

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Informed consent

Approved by the institution ethics committee (IEC), School of Public Health, SRM Medical College Hospital and Research Institute, Kattankulathur, Chengalpattu district, with reference number 0043/IEC/2023, dates 11.12.2023.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish or preparation of the manuscript.

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