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¹ L = Legal agreement, O = Other, P = Plan, PR = Prototype, R = Report, U = User scenario

² PU = Public, PP = Restricted to other programme participants (including the Commission Services), RE = Restricted to a group specified by the consortium (including the Commission Services), CO = Confidential, only for members of the consortium (including the Commission Services)

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Glossary

GDS Global Depression Scale

PSQI Pittsburgh Sleep Quality Index

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1. Introduction

With the aim of **defining chronobiological profiles**, CLOCKWORK project has firstly identified the typology of user that will be the target of the study: **Health care providers**. All over the world, Health care providers - that are bound to work in shifts to cater for the needs of the sick people - are massively exposed to the disruption of the synchronous relationship between the body's internal clock and the environment.

The second target in providing information and data to build these profiles and identifying potential chronobiological disruptions, was to define an approach and the related means/tools of study. Shift working has been investigated from a variety of perspectives within the literature. There are two main approaches from which shift work research mainly derives: **personal** and organizational. Our aim was to focus on the first, analysing the individual perspective. About the means of study. Most of the personal research examines the experience and effects of shift work on individuals from a variety of perspectives such as sleep, coping and health through means of **questionnaires**, hormone testing, sleep testing and reaction time tests. The CLOCKWORK study has mainly used - till now - questionnaires.

Definition of shift work syndrome: **a disruption of the circadian sleep/wake cycle, resulting in insomnia, excessive sleepiness and fatigue.**

For building the chronobiological profiles we are mainly focused on 2 complementary aspects:

1. **Sleep quantity and quality**, without exploring the aspect of the chronotypes.
2. **Psychosocial health**, only analysing the potential signs of depression in the individuals.

Our target of study. **User prototype**: nurse, around 45 years, more than 10 years of shift working, around 11 hours for every night shift.

On the sample as built, we have examined the general data collected through the questionnaires, especially focusing on current or past diseases, which has revealed that obesity, hypertension and diabetes have the most significant incidence, in the order, on the statistic sample object of the study.

2. Statistical tools and data analysis (based on the users' surveys)

A questionnaire to investigate the sleeping habits and health conditions of the shift workers has been developed and administered to a sample of 24 participants (10 in Italy, 10 in Hungary, 4 in Portugal). The content of the questionnaire and the methodologies of data collection are reported in detail in D2.2.

The following parameters have been collected from the questionnaires:

- General data (age, weight, height and number of meals)
- Work environment (number of years spent as night shifter, number of night shift per week, night shifts duration)
- Sleep assessment (See section 2.1)
- Global depression scale (See section 2.2)

Mean value and standard deviation of each parameter have been computed, both over the whole sample and each country (Italy, Hungary, Portugal). The results of such analysis has been reported in D2.2.

2.1. PSQI (Pittsburgh Sleep Quality Index) scoring

In this section, the score methodology for the PSQI is shown. The PSQI is composed by 19 self-rated questions (see table 1) that are combined to compute the score of 7 components.

The total PSQI score is computed as the sum of the scores of all the components.

PSQI				
1. During the past month, when have you usually gone to bed?				
2. During the past month, how long (in minutes) has it taken you to fall asleep each night?				
3. During the past month, what time have you usually gotten up in the morning?				
4a During the past month, how many hours of actual sleep did you get at night?				
4b. During the past month, how many hours were you in bed?				
5. During the past month, how often have you had trouble sleeping because you:	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				

j. Other reason				
6. During the past month, how often have you taken medicine (prescribed or “over the counter”) to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
9. During the past month, how would you rate your sleep quality overall?	Very good	Fairly good	Fairly bad	Very bad

Table 1 Pittsburgh Sleep Quality Index questionnaire

The scoring methodology for each component is shown in the following sections.

- *Component 1 (subjective sleep quality)*

The score is calculated from question 9 as follows:

Answer	Score
very good	0
fairly good	1
fairly bad	2
very bad	3

- *Component 2 (sleep latency)*

Firstly, a score has been assigned to question 2 and question 5a as follows:

Question 2	
Answer	Score
15 minutes	0
16-30 minutes	1
31-60 minutes	2
> 60 minutes	3

Question 5a	
Answer	Score
≤15 minutes	0
16-30 minutes	1
31-60 minutes	2
> 60 minutes	3

The total score of component 2 is computed taking into account the sum of the two previously calculated scores:

Sum of 2 and 5a	Score
0	0
1 - 2	1
3 - 4	2
5 - 6	3

- *Component 3: sleep duration*

The score is calculated from question 4a as follows:

Answer	Score
> 7 hours	0
6-7 hours	1
5-6 hours	2
< 5 hours	3

- *Component 4: habitual sleep efficiency*

First, the number of ours slept has been retrieved from question 4a, and the number of hours spent in bed from question 4b. Then, the habitual sleep efficiency has been calculated as follows: habitual sleep efficiency (%) = (number of ours slept/ number of hours spent in bed) * 100.

Finally, the score of the component is assigned:

Habitual sleep efficiency	Score
> 85%	0
75-84%	1
65-74%	2
< 65%	3

- *Component 5: sleep disturbances*

Each answer for 5b to 5j has been scored using the following table:

Answer	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

The total score of component 5 is computed taking into account the sum of the previously calculated scores of questions 5b-5j:

Sum of 5a-5j	Score
0	0
1 - 9	1
10 - 18	2
19 - 27	3

- *Component 6: use of sleep medication*

The score is calculated from question 6 as follows:

Answer	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

- *Component 7: daytime dysfunction*

Firstly, a score has been assigned to question 8 and question 9 as follows:

Question 8	
Answer	Score
Never	0
Once or twice	1
Once or twice each week	2
Three or more times each week	3

Question 9	
Answer	Score
No problem at all	0
Only a very slight problem	1
Somewhat of a problem	2
A very big problem	3

The total score of component 7 is computed taking into account the sum of the two previously calculated scores:

Sum of 8 and 9	Score
0	0
1 - 2	1
3 - 4	2
5 - 6	3

2.2. GDS (Global Depression Scale) scoring

In this section, the score methodology for the GDS is shown. The GDS is composed by 15 questions (see table 2) that are combined to compute the total score.

	YES	NO
1. Are you basically satisfied with your life?		
2. Have you dropped many of your activities and interests?		
3. Do you feel that your life is empty?		
4. Do you often get bored?		
5. Are you in good spirits most of the time?		
6. Are you afraid that something bad is going to happen to you?		
7. Do you feel happy most of the time?		
8. Do you often feel helpless?		
9. Do you prefer to stay at home, rather than going out and doing new things?		
10. Do you feel you have more problems with memory than most?		
11. Do you think it is wonderful to be alive now		
12. Do you feel pretty worthless the way you are now		
13. Do you feel full of energy?		
14. Do you feel that your situation is hopeless?		
15. Do you think that most people are better off than you are?		

Table 2 Global Depression Scale questionnaire

The score of 1 has been assigned in case of positive answer and 0 in case of negative answer to questions 2, 3, 4, 6, 8, 9, 10, 12, 14 and 15. On the contrary, the score of 0 has been assigned in case of positive answer and 1 in case of negative answer to questions 1, 5, 7, 11, 13.

The total GDS score has been computed as the sum of the score of each question.

3. Qualitative study of sleep practices of shift workers

To better understand the sleep and rest practices of shift workers, we conducted thirteen semi-structured interviews with people working in these conditions. The interviewed participants were recruited through personal contacts of the research team or through a large private healthcare provider from Portugal. Interviews took place in participants' working space or in the research facility of FhP. Two of interviews were conducted over phone. All interviews were attended by two people from the research team, and took around 30 minutes. The interview script focused on the issues, challenges, and characteristics of shift work. While we had an interview script, we offered space for participants to mention other topics that were relevant to them. Interviews were transcribed verbatim and later coded based on a thematic analysis approach (Braun and Clark, 2006).

We recruited 13 participants (6 males, 7 females) who are currently working in shifts. They worked in different areas, from healthcare to security or maintenance. Participants had varied experience working in shifts, ranging from less than a year to 30 years of experience working in shifts. Most participants worked at CUF.

Three main shift patterns emerged during the interviews with shift workers: 1) recurrent night shifts, 2) variable schedules, and 3) slow rotation shifts. The first shift pattern was found on both doctors interviewed. Once a week, and always on the same day of the week, these doctors would have a 24 hours shift followed by a rest day. In the remaining of the week they would have a morning shift. Nurses and medical assistants had a much more variable schedule. They worked during mornings, afternoons, and nights at different times of the month, to suit the needs of their service, their availability, and work law. Nurses and medical assistants worked one or two night shifts every week, and, in exceptional situations, could reach 3 night shifts. Finally, workers with the slow rotation, such as security personnel, worked in the same shift for several days in a row. They could work for five days during the afternoon, have some rest days, and then work for five days during the night. For the majority of shift-workers, weekends and holidays are regular working days.

The calendar of shifts was usually planned once a month. The supervisor manually assigned the schedules, taking into consideration the availability of personnel, special circumstances of the workers (e.g., pregnancy, breastfeeding), and the Portuguese work law. However, the planned timetables did not always correspond to the shifts that workers engaged in. In fact, workers often exchanged shifts between each other in order to accommodate commitments with friends and family.

Table 3 Participants in the interviews

	A ge	Gender	Job	Experience (years)
P01	26	F	Nurse	1
P02	29	F	Doctor	2
P03	39	M	Security officer	8
P04	37	M	Maintenance technician	12
P05	31	M	Doctor	6
P06	51	F	Medical assistant	7
P07	54	F	Nurse	30
P08		F	Medical assistant	8
P09	56	F	Medical assistant	<1
P10	46	M	Medical assistant	12
P11	47	F	Medical assistant	7
P12	50	M	Security officer	13
P13	52	M	Security officer	18

3.2. Issues with the night shift

3.2.1. Work interferes with sleep

Working hours, which prevent individuals from sleeping at the usual times, are factors that considerably harmful for the psychophysiological balance of workers. The worker has the following sleep after the first day of night shift impaired. During the daytime sleep period the body begins to adapt to the hourly inversion. After the return to nocturnal sleep, it is necessary to redo the opposite attitude. The more the reinvestment is postponed, the more difficult it becomes to retrain. Thus, fast rotations would be less damaging: 2, 3 or 4 consecutive days in the same work shift should not be exceeded.

Working schedules that interfere with normal sleep patterns, i.e. sleeping during the day, are known to affect the sleep quality of workers (Åkerstedt & Wright, 2009). Shift work is responsible for the deregulation of normal biological rhythms, forcing the body to adapt efforts that can lead to attrition, with health (physical and psychological), family and social life consequences. The main sources of difficulties arising from shift work are: (1) adaptation of biological rhythms to inversions of periods of activity and rest, (2) sleep disturbances, and (3) domestic and social factors.

Sleep disorders are more frequent when shifts are nocturnal or very early in the morning. In addition to impairment to work performance, reducing the alert can increase the risk of accidents. Sleep deprivation is indicated as the most negative direct impact of shift work, which includes the night shift. As night work disturbs the chronology of sleep, it can reduce its quantity and significantly impair its quality. The magnitude of sleep problems varies depending on the type of work being performed, the shift system, and environmental factors such as noise at work or noise at home during the hours that can sleep. The amount of sleep for night shift workers may be reduced by up to two hours per day, and quality is also reduced, that is, the internal structure of sleep is altered, and the damage accumulates throughout the days, leading to a constant sleep rate.

Predictably, participants reported several issues pertaining to the impact of working during the night in their sleep, such as: Difficulty falling asleep or waking up, light or deregulated sleep, not sleeping enough, mood changes, or a general decrease in sleep quality were generally brought up by the workers interviewed.

Given the type of work that some participants have, readiness is usually a requirement for the job. This can happen during the rest time in the middle of the shift, like P02, who needs to be always on alert to answer to request from the emergency, or even them they are at home on call and have to be ready to go back to the hospital if there is an emergency (P07).

P02: It [the sleep] is very superficial, yes. Anything and you notice it. Because we are more uneasy, more sensitised somehow. I'm the [healthcare] answer [to emergency requests], if something comes I have to be on alert, I need to be capable of acting. So, maybe our body doesn't turn off that often. (Doctor)

P07: [When on Prevention]: It's not a night that I sleep well, because I'm always afraid not to hear the phone, (...) So I am always (waking up). It happens often. It's not just me that we often talk about it. I take a shower I lie in the same, quietly, but ... I fall asleep very well but I am able to wake up 3, 4, 5 times ... (Nurse)

These type of work-related disturbances can have a lasting effect on sleep quality, both in terms of duration and consistency. Participants reported sleeping fewer hours, and were more likely to wake up in middle of their sleep. Given that the bright environment of the day is not propitious for sleeping, workers have close blinds in order to make the room completely dark. And while the room brightness can be controlled, unfortunately, environmental noise cannot. There are much more noise during the day, which is especially distracting since workers sleep is already lighter.

While establishing a direct a connection between shift working and difficulty falling asleep and waking up might not be always possible, participants complained about these kind of problems. For instance, P04 have noted difficulty falling asleep in particular when he did not go to bed before a certain time, in his case, if he stayed awake past midnight. Some strategies would help participants falling asleep, such as leaving the TV on, and on some more serious cases, to take sleep medication.

P03: There are colleagues who come to bed and fall asleep like a stone (...) I Do not. During the day I consider sleep to be different. It costs me to fall asleep, I don't know why. (...) I feel that sleep during the day is not the same as during the night. At night, when we lay down we fall immediately. During the day I think it's different (...)I hear more noise.

P04: (Waking up) for example on the day that I sleep a few hours, is the alarm clock that gets me out of bed and it's hard to get out of bed. But it has to be, that day has to be because if I ... It happened to me, for example, the alarm clock rang and I turned it off and sometimes I'm so tired that it's almost ... I do not even remember that I have turned the alarm off. That's almost automatic. And then I wake up when I wake up. (Metro Technician)

There were also the psychological effects on shift workers, namely on their mood, with workers reporting an overall bad mood and frustration following a night shift. Things that would be easier to do on a normal psychological state, become much more demanding on a sleep deprived state.

P02: I get really upset. The next day no one puts up with me. But I'm not the only one. Generally speaking, no, not everybody stays in a bad mood the next day. And with very little patience. But the reality is that we know that there are immense factors that interfere with our personality, namely, sleep deprivation. (Doctor)

3.2.2. Accumulated fatigue

Accumulated fatigue was an expression used by a few workers to describe the state of tiredness after a sequence of days and nights without appropriate rest. In this view, tiredness is not just the result of a single event but a consequence of accumulated efforts through a longer period of time.

P05: Monday I don't work because I'm coming from the night, when I do Sunday. But then I start the week again. More 6 days, more 5 days, from Tuesday to Saturday. And that can happen to have accumulated fatigue. (Doctor)

P13: It's not tiredness. It's the accumulated fatigue (Security officer)

There is a toll on the body, in particular when workers are not able to completely recover from the previous sleepless night shift on their rest day.

P02: It takes me 3/4 days to recover from a night at the ER. I notice that my study, my performance is not the same. I cannot find myself the same way. I don't have the same tolerance. I cannot stand stay sit doing the same thing. I don't feel like myself. I notice that I am different. (Doctor)

3.2.3. Making mistakes or unwise decisions

Sleep loss is known to impair individuals' self-control, such as resisting impulses and attentive behaviour (Pilcher, Morris, Donnelly, & Feigl, 2015). When one is tired there is a diminished level of tolerance and endurance for the job. The patience for dealing with people and situations that otherwise would be manageable diminishes, therefore more mistakes and unwise decisions are likely to surface. There is a balancing act between what is the right thing to do and the energy required to do that action, and for workers on a sleep deprived state, the energy to work at their best is sometimes missing.

P02: I think it's a bit about managing the effort because it takes much more effort to use that energy and time to explain to people who are going to counter later [...] — just take the antibiotic. (Doctor)

P02, who was a physician, revealed that she would prefer to prescribe antibiotics to children who might not need it, rather than having to spend time arguing with the parents why the antibiotics would be unnecessary in that case. She was capable of acknowledging that her work during the night shift did not have the same quality as the work during the day, and even though there was enough self-awareness to understand the impairing effects of the sleep deprivation, there was not enough energy to counteract its effects.

3.2.4. Adjusting to a new shift

While adjusting to a new shift is more or less a troubling event for every shift worker, with any kind of night shift, workers who have several night shifts in a row did seem to have the most difficult time adjusting to the new schedule.

P04: [...] That is the first, second night. Getting used to again to [night] shifts is hard. Very hard. And also one of the worst. Going from the night to the day, and going from all those days in a row right to the nights it's... it takes a lot. (Doctor)

Although fixed night shifts have the potential benefit to ease the adjustments of the circadian clock (Folkard, 2008), such shift pattern requires workers to be almost permanently adjusted to the night shift. However, for workers in the slow rotation shifts that we interviewed, there were frequent — though not frequent enough — shift changes that would put workers in an almost constant state of adaptation to a new schedule. Circadian rhythms seldom adjust for more than 1h/day (Folkard, 2008), therefore a 4 to 5 days cycle was not enough to complete the adaptation. When workers would start to become adjusted to the new schedule, a new cycle begins, as well as the adaptation process. Workers would be on a constant state of adaptation.

P13: In the last days I start to get into that routine. I get into that routine. And when I'm starting to get into that routine, it's time to change. It's not easy, it's not easy. They say it's a matter of habit. What I know it's that I'm in this for 18 years and never got used to. (Security officer)

3.2.5. Not falling asleep during work

Staying awake during the night, while executing demanding tasks that require a significant effort and concentration does not put workers on a state of sleepiness. While attending a critical patient, doctors or nurses do not get somnolent. However, not falling asleep during the night shift for workers who have a particularly repetitive and slow job is much more challenging.

P12: I'm not going to lie. No one says never. We are like this, from one moment to the other we are with our eyes closed. Sometimes it happens. (Security officer)

Whereas nurses can have some rest time during the slowest moments of the night since their job does not require continuous attention, workers like P12, who work as a security officer, need to stay on alert during the entire duration of the shift. Moreover, their job required them to spend all night looking at a video monitor on an environment without much stimulus.

Not falling asleep during duty is a major concern of such workers since the nature of the job requires them to stay always on alert. Interviewees were upfront to acknowledge that is quite hard to stay awake, and that some dozing is inevitable. Nevertheless, they were quite afraid of falling asleep and the consequences if someone found out.

Another context in which not falling asleep is critical is when workers have to go back home after the night shift. After a sleepless night workers will be tired, sleepy, and ready for bed, while the morning lights shine into their eyes. This is especially worrisome when workers have to drive back home, and as it was revealed by one participant who had actually slept for a brief moments while stopped at the red light. In this particular case everything ended up fine, but ultimately, the dangers for worker and other people on the street is not to dismiss.

3.2.6. Working with screens

While the bright lights in the work environment can be a source of disturbance, a more relevant issue comes from having to work at the computer. First, computer-related activities were considered to be more tiresome because the effects of the screen luminosity on the eyes. The other issue pertains to the type what activities that are typically carried out in the computer, which were in general more monotonous.

P05: Sometimes, I almost fall asleep in front of the computer. So I don't think it keeps me awake. [...] You know, it is a boring task. If I were in front of a critical patient that would not happen (Doctor)

While working in front of the computer can wear out P05 more easily than working with patients on a stimulant environment, working with computers is just a very small part of his job. However, this issue is particularly common with security officers, which are required to spend almost all night looking at a video monitor, showing a mostly static image, on a silent room.

3.2.7. Adjustments to social life

Besides the direct physical and physiological effects of shift working on the worker, one should also have to consider the impact of working in shifts on the family and friends of the worker.

Given the typically erratic schedule of working in shifts, conciliating one's schedule with the family and friend, whether they also work in shifts, like the case of P1's friends, or have a "normal" job, is challenging

P01: At the social level it affects a lot, firsts because part, or most of the people I'm in contact with also work in shifts. (Nurse)

Difficulty conciliating activities with friends and family was recurrently mentioned by participants as a significant issue. At the end participants have to forego some activities either because they are working or because they need to rest.

Another characteristic of shift working is the lack of distinction between workdays and weekend or other holidays. Any day can be either a work or a rest day. For workers such arrangement becomes the norm, but it might be much more difficult to understand for relatives since there is less time to be with family and friends.

P04: For me Christmas is a work day. It's a day off or not. For me holidays are a normal day like any other. Weekend is a day like any other. (Maintenance technician)

3.2.8. Limited control of the environment

Another theme of the conversations pertain to issues related to the working space. There is a limited control of the lighting of the space, since the lights of the main aisles are controlled centrally, typically by the security. Lights are turned off, or dimmed during the night at a predetermined time, and are then turned back on in the morning. Therefore, there is no direct control of the light by the workers. However, there are some lights in the rooms that can be controlled individually by workers.

3.3. Strategies for preparing for the night shift

Night shifts are prone to be a disruptive moment in workers life, both in terms of the effects on the body, and the impact on their social life and daily routines. Therefore, there is the necessity to prepare for such situation, in order to make working during night more bearable.

3.3.1. Pre-shift rituals

To maintain a balanced and stable life, with little change as possible, workers aim to keep up with their daily routines as much as possible. And when looking at their routines, particular consideration is given to the routine before the night shift.

P08: Around 5h30-6h I start to prepare. I take a shower. Because I have to leave early because I don't know the traffic I'm going to get in order to get here at 7h45 to be [working] at 8h. (Medical assistant)

Such routines before each night shift can be understood as a personal ritual to prepare the worker for the night shift. For instance, P08 would start to prepare a few hours before the shift, would take a shower and leave. Other workers would prefer to take a nap or to eat in preparation for the night shift. Napping, taking a shower, eating are common pre-shift activities; however, the actual ritual, activities,

and order of the activities are personal preference. Nevertheless, what is noteworthy is this pre-shift ritual to prepare workers to endure working during the night

3.3.2. Preventive sleep

A particular and significant pre-shift ritual common to many interviewees are the naps in the afternoon before the night shift, which are known to have a beneficial effect on shift workers, especially for workers on a counter clockwise rotation (Garbarino et al., 2004). Although compensating for the lost sleep is not entirely possible, workers look to prepare for the sleepless night by resting and sleeping during the previous day.

P09: I have a system, don't know if it's shared by other colleagues, in the days that I do nights I wake up early and after lunch, around 3 o'clock I lay down for a bit. Sleep around 2 hours, 2 and a half. Then I take a bath and I'm ready. (Medical assistant)

Amidst the several steps of the daily routine of P09 there is moment for napping in the afternoon before the night shift. And while P09 and many other interviewees seem to take a nap as part of the pre-shift routine, others workers reported that they cannot sleep during the day.

3.4. Strategies for dealing with the night shift

By its nature, the night shift is typically the quietest period of the day. There are less people to attend to and fewer activities to complete. Although the job can be less stressful at a times, it can also be more monotonous. Not falling asleep and being always on alert during the shift is a major concern for some workers. Therefore, overall the strategies to deal with night shifts dwell upon how can one stay alert and endure the entire night.

3.4.1. Keeping oneself busy

During the night shift there are fewer things to do, thus, more opportunities to be bored and fall asleep. To keep oneself on alert, workers have to come up with tasks to keep them busy during the slower times of the shift.

P06: I would try to move. To do something. Or folding bags or do something to keep wake me up. [...] I would come up with something, right. Because there are some things that we cannot do during the day, we do that at night. Small things, folding bags, to put things in order. (Medical assistant)

Moreover, some jobs (e.g. nurses) have activities that can be described as “night tasks” because they are typically done during the night, though they can be executed at any time during the day. These are usually ordinary and less urgent tasks, such as folding bags, or reloading carts, that can be completed during the slower moments of the shift, or when there is some free time available.

3.4.2. Talking with someone

Without the agitation and noise of the day shift, there is the need to introduce additional stimulus to help one stay awake. Since the slow moments are a catalyst of drowsiness, having someone to talk to can help one stay on alert and let the time pass. Whether is work related or solely small talk, the conversation does not require a clear goal.

P12: Then we go to the ER. We talk with the man at the ER, or woman. It helps. The cleaning personnel also. (Security officer)

P13: Sometimes we pick up the radio. Talking with the colleague also helps. Even if it is just taking about... — where are you going tomorrow, tomorrow it's your day off. (Security officer)

3.4.3. Eating and drinking

Taking a break to eat or drink is something that most of our participants do during the shift. This would be a time not only to provide some energy, but also a moment to have some rest. While workers used time to eat or drink as a moment to make a break and recharge energy, not everybody seems to be able to bear food during the night period.

P02: When I'm sleepy what I usually is to eat. I eat some cookies. I eat something that give me energy. Chocolate, dried fruits. That allows me to stay awake, and I can also rest a bit. I rest a bit. It's very difficult to stay awake during the night. (Nurse)

P03: I can't. My body, my metabolism don't... I become sick, heartburn, sick. I like to have a coffee, but I don't drink anything. (Security officer)

In addition to food and drinks, some workers reveal that they drink caffeinated beverages (i.e. coffee or cola) in order to help them go through the night. While coffee is used as a stimulant by some people, others report that drinking coffee is something they just do out of habit and pleasure. They no longer feel the effects of caffeine on their bodies. Furthermore, alcohol was also mentioned as something to avoid before the night shift because of the negative in the body.

3.4.4. Having some rest time

Planned napping during the night shift can be used effectively to counteract sleepiness in workers (Sack et al., 2007), however, the characteristics and rules of the job do not always permit such rest time, e.g. security officer. For jobs that allow it, taking a moment to rest can help one endure an entire night of sleeplessness. While there is not an official resting period, workers will some slower moments during the night to get off their feet.

P08: There are colleagues that end up, if the shift allows it, resting a bit. I'm not going to say I don't sit down. I sit to rest my legs a bit after all the work is done. But I cannot sleep during the night, I cannot sleep. (Medical assistant)

Furthermore, some jobs, for example physicians, allow for a more sleep time if there are not many urgencies during the night. Physicians in the ER would have their own room to sleep if the work allowed it, and in case of an emergency someone would be there to wake them up.

P05: I think I take about 2h [of sleep] almost every time. Eventually, sometimes we have a bit less. But I can rest at least 2 hours. [...] We have a room, with bathroom, etc. So, our own space. (Doctor)

3.5. Strategies for recovering from the night shift

3.5.1. Sleeping or resting during the day.

Sleeping, taking a small nap, or just resting during the day is typically used to cope with the sleep deprivation of the previous night. The time of the day seems to be important, with most workers preferring to sleep or rest only after lunch. When coming the night shift, even if tired, workers would keep their normal routine during the morning, and some were resolute to state they could not sleep at all during the morning, only in the afternoon.

P3: I can have a little nap from time to time, but it's difficult. It's very difficult. (Security officer)

P11: When I do nights, I come from the night, I do my stuff. Even if it's just 2 hours lied down on the couch, I try to stay those 2 hours. I may be awake, but I try to rest those 2 hours. [...] Maybe it brings me energy for the night. (Medical assistant)

The purpose of this sleep time is not to replace the sleep lost in the previous night, but rather to help the body to recharge energies to keep them going through the day. Given that two night shifts in a row are avoided in workers schedules (except for workers in longer shift rotations), a full night sleep will follow at the end of the day.

3.5.2. Skip the usual sleep

Workers intentionally aim to restrain from sleeping during day to avoid to deregulate their circadian clock. Attempting to replace the sleep lost could affect their internal clock, therefore it is preferable to have fewer hours of sleep and keep the internal clock synced with their normal sleep schedule [ref].

P10: I come from the night, rest-day off [...] I don't go straight to the bed. I try to hold on. If I sleep during the day, I know I will not be able to sleep during the night. So that day to I try to stay more time awake. (Medical assistant)

P12: Sometimes, when I come from the nights, on the last night I don't go to bed. I go, for example, shopping. (Security officer)

3.5.3. Post-shift rituals

Given the disruptive nature of shift working in people's lives, there is the inclination to establish rituals that makes one's life seem more normal. As the rituals that workers have for preparing for the night shift, rituals for the recovering from the night shift aim to accomplish that.

P02: In the next day I go home, take a bath, breakfast, and sleep. (Doctor)

P09: And in the morning when I leave from here, the first thing [is to] eat breakfast, taking a bath, and lay down. (Medical assistant)

P10: I leave from here and go home. [...] Getting home, taking a shower, breakfast, and go to bed. (Medical assistant)

4. Clinical perspective

The applied questionnaires allowed us to come to some conclusions about the inquired shift workers' quality of sleep and depression level. The scorings obtained per country are presented below.

Because the number of inquired shift workers varies in Portugal (only 4, versus 10 in Hungary and Italy), a linear comparison among these countries cannot be performed.

Country	Number of inquired shift workers	% of shift workers with poor sleep quality	% of shift workers with sleep onset insomnia	% of shift workers with sleep maintenance insomnia or early morning awakening	Average number of hours of sleep/day	% of shift workers with less than 6h of sleep/day	Final PSQI score mean
Hungary	10	40%	0%	30%	6.9	30%	4.7
Italy	10	20%	10%	10%	6.3	10%	4.9
Portugal	4	50%	25%	50%	6.3	50%	7.0
Total	24	33%	29%	25%	6.5	25%	4.0

Table 4 Results of applied PSQI questionnaires

PSQI scoring allows a sleep assessment to be performed. A PSQI total below or equal to 5 is associated with good sleep quality, whereas a total above 5 is associated with bad sleep quality. In spite of this scale, it is especially useful, when it comes to performing a complete sleep analysis, to analyse the existence of sleep onset insomnia, sleep maintenance insomnia or early morning awakening, as well as to check if the person is sleeping less than 6 hours per day, both signs of low sleep quality.

4.1. Sleep Quality

The questionnaires results allowed us to see that the number of inquired shift workers with poor sleep quality (PSQI > 5) varies significantly per country: 40% in Hungary, 20% in Italy and 50% in Portugal.

4.2. Insomnia

From the PSQI scoring, it is also possible to evaluate the level of insomnia of the questionnaire participants. Those who, in the Sleep assessment, answered questions 5a. or 5b. (see Table 1 Pittsburgh Sleep Quality Index questionnaire) by choosing the option “Three or more times a week”, were considered respectively, to have sleep onset insomnia and sleep maintenance insomnia/early morning awakening.

We can see that in Hungary no participants have sleep onset insomnia and 30% have sleep maintenance insomnia/early morning awakening; in Italy, the numbers change to 10% for each type of insomnia, while in Portugal, the values are 25% and 50% respectively.

4.3. Hours of sleep per day

The average of hours of sleep per day is similar among countries: 6.9h in Hungary and 6.3 in both Italy and Portugal.

Going deeper and analysing the number of hours that the participants sleep per night allows us to see that in Hungary 30% of the inquired shift workers have a short sleep duration (less than 6 hours per day), a number that changes to 10% in Italy and 50% in Portugal, which may be a sign of sleep deprivation or insomnia.

Globally, Hungarian and Italian inquired shift workers presented good sleep quality (PSQI≤5) with a final score mean of 4.7 and 4.9, respectively. Portuguese shift workers presented a higher final score mean, 7.0, implying poor sleep quality (PSQI>5).

4.4. Global Depression Scale (GDS)

The GDS evaluates the level of depression of a person. A total score of 0-4 is associated to a person not depressed, values of 5-7 to a person mildly depressed, 8-11 to a person moderately depressed and 12-15 to a person severely depressed.

Country	Number of inquired shift workers	% of shift workers not depressed	% of shift workers mildly depressed	% of shift workers moderately depressed	% of shift workers severely depressed	Final GDS score mean
Hungary	10	70%	30%	0%	0%	2.4
Italy	10	70%	20%	10%	0%	3.1

Portugal	4	50%	50%	0%	0%	5.0
Total	24	67%	29%	4%	0%	2.3

Table 5 Results of applied GDS questionnaires

30% of the inquired Hungarian and Italian shift workers presented some level of depression (mild or moderate), whereas 50% of the Portuguese presented mild depression (where the sample was much smaller, thus not allowing for a linear comparison).

Globally, Hungarian and Italian inquired shift workers presented no level of depression (≤ 5) with a final score mean of 2.4 and 3.1, respectively. Portuguese shift workers presented a higher final score mean, 5.0, implying mildly depressed people (>5).

5. Conclusions

For assessing sleep quality, we have used the ***Pittsburgh Sleep Quality Index (PSQI)***, that is an effective instrument to measure the quality and patterns of sleep in adults. It differentiates “poor” from “good” sleep quality by measuring seven areas (components/factors), over the last month:

- (1) ***Subjective sleep quality.***
- (2) ***Sleep latency.***
- (3) ***Sleep duration.***
- (4) ***Habitual sleep efficiency.***
- (5) ***Sleep disturbances.***
- (6) ***Use of sleeping medication.***
- (7) ***Daytime dysfunction.***

For all the components (factors) related to sleep quality and quantity assessment, used for building the chronobiological profiling of our statistic sample, a score of “0” indicates no difficulty, while a score of “3” indicates severe difficulty. Intermediate scores indicate conditions that can be assessed as **fairly good “1”, and fairly bad “2”**.

Total score of the PSQI questionnaire. Total score ranges between “0”, indicating **no difficulty**, and “21”, indicating **severe difficulties in all the areas**. A total score of “5” or greater, is anyway indicative of a poor sleep quality, and in this case, it is suggested to discuss individual’s sleep habits with a healthcare provider.

- **Italy**, average score over 10 individuals: **4.9** → fairly good sleep quality.
- **Hungary**, average score over 10 individuals: **4.7** → fairly good sleep quality.
- **Portugal**, average score over 4 individuals: **7** → fairly bad sleep quality. **Too small sample of individuals to be statistically meaningful.**

Psychosocial health. The ***Global Depression Scale (GDS)*** was used - as a self-report tool - to screen for clinical depression and psychosocial impairments.

On 24 individuals examined, 16 subjects resulted to have a **normal depression level (66.7%)**, 7 subjects resulted to have a **mild depression level (29.2%)**, 1 subject resulted to have a **moderate depression level (4.1%)**, 0 subject resulted to have a **severe depression level**.

Summarizing the conclusions:

1. **The statistic sample studied does not present severe or moderate signs of chronobiological disruptions related to sleep quantity and quality assessment, except for the Portuguese shift workers, but this specific sub-sample was too small in number (4 individuals), to be statistically representative.**

2. **Psychosocial assessment does not present any subject with a severe depression level**, and the majority of the sample (66.7%), was evaluated with normal psychosocial behaviour.
3. **Health status related to current or past diseases has revealed that obesity, hypertension and diabetes have the most significant incidence**, in the order.

Suggestions for future improvements - related to the identification of benchmarks to be used during the field trials - and relatively to circadian activity parameters:

1. **Enlarge the users' (statistical) sample**, prevalently in Portugal where the PSQI results have shown the presence of chronobiological disruptions.
2. **Integrate the data collected with psychosocial questionnaires.** Suggested is the World Health Organization Quality of Life Assessment Instrument - WHOQOL - standardized questionnaire designed **to evaluate individuals' quality of life by recognizing its multidimensional nature and emphasizing personal perceptions of it.**
3. Use the Morningness-Eveningness Questionnaire (MEQ) and the Munich ChronoType Questionnaire (MCTQ) to **integrate the chronotype assessment (MCTQ), and the circadian typology of sleep.**

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