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Article

Variation on Work Demands and Sleep Disturbances Concerning Fixed and Rotating Shifts in the Water, Sanitation, and Waste Sector

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Abstract: The growing production of waste and increased use of water and sanitation systems worldwide have been pressuring the water, sanitation, and waste sectors. This study analyzed the perception of the determinants of work activity among workers from the water, sanitation, and waste sector in Portugal, the variation in the work demands among different shift types, and the main predictors of sleep disturbances. Data collection was performed through a questionnaire administered to 300 workers in 2017 and 2019. An ageing population was identified in all shift types. Possible occupational trajectories with changes from the fixed night and early morning shifts to daytime and fast rotating shifts may be linked to health conditions. Workers in fixed night and early morning shifts perceived higher physical demands and environmental discomfort, lower social support, and job dissatisfaction. Workers in daytime or fast rotating shifts perceived higher cognitive demands. Sleep disturbances were perceived more negatively among those working permanently on night and early morning shifts. The main predictors of sleep disturbance in both years were the type of shift, and high physical demands. The study highlights the relevance of characterizing the work demands to establish future strategies to improve the health and well-being of shift workers.

Keywords: sleep disturbances; water; sanitation; waste sector; fixed and rotating shifts; night shifts; work determinants; human factors

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1. Introduction

The development of cities with a growing production of waste and increased use of water and sanitation systems has been pressuring the water, sanitation and waste sectors managed by municipalities in Portugal. Municipalities manage the collection and haulage of waste and perform the maintenance of water and sanitation systems related to household and economic and public activities, such as restaurants, schools and companies [1]. Municipalities have blue-collar workers devoted to regular waste collection and the maintenance of the water and sanitation systems. These tasks are mainly physically demanding, but, in the last few decades, the implementation of organizational and technological changes aimed to improve the efficiency and sustainability of the water, sanitation and waste sector [1]. These services offered to all urban and country populations often implicate a 24 h work activity, with shift and night work. The exposure of workers to shift work and night work has well-described consequences, such as the perturbation of sleep and wake cycles and the modification of the activity and rest pattern [2]. Frequent consequences of shift and night work are sleepiness and fatigue during work periods, health impairments and increased safety risks [2,3]. In addition, work conditions may vary among different shift types, depending on the nature of the tasks, the number of workers, the work pace, the presence of supervisors, and other factors [3,4]. Physical and psychosocial characteristics of work influence workers' sleep and may have a cumulative effect on shift work. Higher job demands, such as quantitative demands, role conflict, decision control and social support [5–7], and environmental exposure to noise or heat stress are related to poor sleep quality [5], and high physical workload is associated with sleep problems and fatigue [3]. In the literature, night shifts relate to more negative effects on health and social relations [8], with workers facing more difficulties coping with and leaving these types of shifts earlier in work life [9].

Generally, municipal workers belong to different occupational categories with diverse activity demands, and are an ageing population [10]. Those belonging to the water, sanitation and waste sectors are less focused on research but exposed to high physically demanding tasks, outdoor work, shift work, and psychosocial risk factors [11]. Still, there is a gap in research regarding the differences in the perception of working conditions between distinct shifts among workers from the water, sanitation, and waste sectors and the consequences for sleep disturbance.

The present study aimed to characterize the perception of the main determinants of work activity among workers from the water, sanitation, and waste sectors in Portugal, in 2017 and 2019, analyze the variations in the work demands among different types of shifts, and identify the main predictors of sleep disturbance in 2017 and 2019.

An ageing population was identified in all shift types. Possible occupational trajectories with changes from the permanent night and early morning shifts to daytime and fast rotating shifts may be linked to health conditions. Workers in fixed night and early morning shifts perceived higher physical demands and environmental discomfort, lower social support, and job dissatisfaction. Workers in daytime or fast rotating shifts perceived higher cognitive demands. Sleep disturbances were perceived more negatively among those working permanently on night and early morning shifts in both data collection moments. The main predictors of sleep disturbance in 2017 and 2019 were the type of shift, namely, night and early morning shifts, and high physical demands.

2. Materials and Methods

The study design encompassed two data collection moments (2017 and 2019) within the same working population.

2.1. Participants

The study population consisted of all workers from the Solid Waste Division and Water and Sanitation Division from the Water, Sanitation, and Waste Sector (SMAS) in the municipality of Sintra, Portugal. In 2017, the study population comprised a total of 484 workers, and in 2019 a total of 575 workers were part of this year's study population. All workers were invited for the study, but the participants were selected based on inclusion criteria: being a worker at SMAS for at least six months; voluntary participation. In 2017, the sample consisted of 300 males, followed up in 2019.

The workers were grouped in the Solid Waste Division (SoWD) with two fixed shifts (23:00–06:00 and 06:00–13:00), and the Water and Sanitation Division (WaSaD) with one fixed shift (08:00–16:00) and one fast forward rotating schedule (with three eight hours shifts: 08:00–16:00; 16:00–24:00; 24:00–08:00).

An exclusion criterion was defined based on the identification of shift types that did not match those usually used in the division to which the worker belonged. Based on this criterion, 6 participants were excluded in 2017 and 10 in 2019. These participants were excluded from the analysis because the exposure to work demands regarding the type of shift and division pair were not similar. The final samples included 294 workers in 2017, and 290 in 2019.

2.2. Data Collection

Data collection comprised a questionnaire administered to all workers during a 30 min interview. The questionnaire included three parts: the first aimed at characterizing the socio-demographic variables, such as age, work seniority, and division; the second, based on the questionnaire used by Cotrim et al. (2019) [10], included postural and organizational work determinants concerning the type of schedule, sleep duration, perception of fatigue after work, perception of environmental discomfort (temperature, noise, and vibration), and perception of postures adopted during work activity; the third part regarded the evaluation of psychosocial risk factors, health and sleep disturbances using the Portuguese Middle version of the Copenhagen Psychosocial Questionnaire (COPSOQ II) [12].

2.3. Ethical Procedures

The general principles of ethics in scientific research were considered and the study was approved by the Ethics Committee of the Faculty of Human Kinetics, University of Lisbon (protocol code 21/2017). All workers participated voluntarily and gave informed consent before taking part in the study.

2.4. Statistical Analysis

All statistical analyses used SPSS Statistics (version 25) and considered a significance level of 5%. Summary data comprised mean and standard deviation (SD), or frequency and percentage, according to the type of variable. For quantitative variables, normality and homogeneity of variances assumptions were verified using the Shapiro–Wilk test and Levene's test, respectively. For each data collection moment, types of shift comparisons were performed using the Chi-square test for homogeneity of qualitative variables, the Kruskal–Wallis test for quantitative variables that did not meet the normality assumption, ANOVA with Welch correction for quantitative variables that did not meet the homogeneity of variances assumption, and ANOVA for quantitative variables that verified the normality and homogeneity of variances. A stepwise linear regression was performed to identify the significant predictors of sleep disturbance in each data collection moment.

3. Results

All the results are grouped by type of shift and division, given the diverse nature of the tasks and the allocation of night and early morning shifts to SoWD and day shift and rotating shifts to WaSaD.

3.1. Socio-Demographic Characteristics

Globally, SMAS presented an ageing working group: in 2017, the mean age was 50.3 years old, rising to 52.5 years in 2019, but there were no significant differences among shift types. Regarding seniority, the group of workers from SoWD with a fixed night shift (23:00–06:00) had the lowest seniority and differed from both groups belonging to the two types of shifts of WaSaD (8:00–16:00 and rotating); the same happened with the fixed early morning shift (06:00–13:00) differing from both WaSaD shift types. The duration of sleep was shorter after the night shift and statistical differences were found between shift types (Table 1).

Table 1. Mean (SD) of age, work seniority and sleep duration in 2017 and 2019 by shift type, and shift types comparisons.

2017	SoWD (n = 82)		WaSaD (n = 212)			Shift Type Effect	
	Fixed Night (n = 33)	**Fixed Early Morning (n = 49)**	**Fixed Daytime (n = 126)**	**Rotating (n = 86)**	**Total (n = 294)**	***F***	***p***
Age (years)	47.91 (10.53)	48.43 (10.20)	51.38 (9.93)	50.62 (9.57)	50.28 (9.98)	1.740 [a]	0.159
Work seniority (years)	7.15 (8.52)	4.55 (6.02)	16.13 (11.01)	15.47 (12.28)	13.00 (11.45)	32.852 [b,c]	<0.001 *
Sleep duration (h)	4.61 (0.76)	5.25 (1.00)	6.31 (1.30)	6.03 (0.88)	5.87 (1.23)	37.036 [b,e]	<0.001
2019	**SoWD (n = 94)**		**WaSaD (n = 196)**			**Shift type effect**	
	Fixed night (n = 36)	**Fixed early morning (n = 58)**	**Fixed daytime (n = 117)**	**Rotating (n = 79)**	**Total (n = 290)**	***F***	***p***
Age (years)	49.47 (11.85)	51.07 (9.49)	52.79 (9.31)	53.57 (10.21)	52.45 (9.96)	1.487 [a]	0.218
Work seniority (years)	8.92 (8.17)	6.29 (5.56)	18.04 (10.78)	16.94 (12.01)	14.26 (11.13)	37.320 [b,d]	<0.001 *
Sleep duration (h)	5.17 (0.88)	5.40 (0.94)	6.38 (1.31)	6.03 (0.87)	5.94 (1.17)	18.738 [b,d]	<0.001 *

[a] ANOVA. [b] ANOVA with Welch correction. [c] Games–Howell multiple comparisons test showed significant differences between fixed night and fixed daytime, fixed night and rotating, fixed early morning and fixed daytime, and fixed early morning and rotating shift types ($p < 0.001$ for all comparisons) (There were no significant differences in work seniority between the two SoWD shift types or between the two WaSaD shift types). [d] The Games–Howell multiple comparisons test showed significant differences between fixed night and fixed daytime, fixed night and rotating, fixed early morning and fixed daytime, and fixed early morning and rotating shift types ($p < 0.001$ for all comparisons) (There were no significant differences in work seniority between the SoWD shift types or between the two WaSaD shift types). [e] The Games–Howell multiple comparisons test showed significant differences between fixed night and fixed early morning ($p = 0.010$), fixed night and rotating ($p < 0.001$), fixed night and fixed daytime ($p < 0.001$), fixed early morning and fixed daytime ($p < 0.001$), and fixed early morning and rotating shift types ($p < 0.001$) (There were no significant differences in sleep duration between the two WaSaD shift types). * $p < 0.05$.

3.2. Postural and Environmental Determinants of Work Activity

The workers' perceptions about the types of demands related to their work activity were mainly physical, and differences between the two divisions' shift types were present in both data collection moments. The WaSaD workers reported a higher percentage of both mental and physical demands in their work activity (Table 2).

Table 2. Perception of work demands (Frequency (%)) in 2017 and 2019 by shift type and results of Chi-square test for homogeneity comparing shift types.

2017		SoWD (n = 82)		WaSaD (n = 212)			Shift Type Effect	
		Fixed Night (n = 33)	**Fixed Early Morning (n = 49)**	**Fixed Daytime (n = 126)**	**Rotating (n = 86)**	**Total (n = 294)**	χ^2	***p***
Work Demands	Mental	3 (9.1%)	5 (10.2%)	5 (4.0%)	5 (5.8%)	18 (6.1%)	33.408	<0.001 *
	Physical	23 (69.7%)	39 (79.6%)	72 (57.1%)	33 (38.4%)	167 (56.8%)		
	Both	7 (21.2%)	5 (10.2%)	49 (38.9%)	48 (55.8%)	109 (37.1%)		
2019		**SoWD (n = 94)**		**WaSaD (n = 196)**			**Shift type effect**	
		Fixed night (n = 36)	**Fixed early morning (n = 58)**	**Fixed Daytime (n = 117)**	**Rotating (n = 79)**	**Total (n = 290)**	χ^2	***p***
Work Demands	Mental	3 (8.3%)	6 (10.3%)	4 (3.4%)	4 (5.1%)	17 (5.9%)	27.923	<0.001 *
	Physical	23 (63.9%)	42 (72.4%)	66 (56.4%)	29 (36.7%)	160 (55.2%)		
	Both	10 (27.8%)	10 (17.2%)	47 (40.2%)	46 (58.2%)	113 (39.0%)		

* $p < 0.05$.

The perception of the adoption of postures with upper limbs above the shoulders and the flexion of the trunk was more frequent among night shift workers, and differences between the shifts were statistically significant in both years. The posture with trunk rotation presented a higher frequency among those workers of night shifts, with significant differences in 2019 (Table 3).

Table 3. Perception of upper limbs (above shoulders) and trunk (flexion and rotation) (Frequency (%)) in 2017 and 2019 by shift type and results of Chi-square test for homogeneity comparing shift types.

2017		SoWD (n = 82)		WaSaD (n = 212)			Shift Type Effect	
		Fixed Night (n = 33)	Fixed Early Morning (n = 49)	Fixed Daytime (n = 126)	Rotating (n = 86)	Total (n = 294)	χ^2	*p*
Upper limbs above shoulders	Very Frequent	18 (54.5%)	17 (34.7%)	29 (23.0%)	25 (29.1%)	89 (30.3%)	14.899	0.020 *
	Sometimes	8 (24.2%)	23 (46.9%)	72 (57.1%)	45 (52.3%)	148 (50.3%)		
	Seldom	7 (21.2%)	9 (18.4%)	25 (19.8%)	16 (18.6%)	57 (19.4%)		
Trunk Flexion	Very Frequent	17 (51.5%)	17 (34.7%)	28 (22.2%)	26 (30.2%)	88 (29.9%)	12.563	0.050 *
	Sometimes	10 (30.3%)	24 (49.0%)	75 (59.5%)	44 (51.2%)	153 (52.0%)		
	Seldom	6 (18.2%)	8 (16.3%)	23 (18.3%)	16 (18.6%)	53 (18.0%)		
Trunk rotation	Very Frequent	17 (51.5%)	15 (30.6%)	30 (23.8%)	30 (34.9%)	92 (31.3%)	11.510	0.073
	Sometimes	11 (33.3%)	23 (46.9%)	74 (58.7%)	41 (47.7%)	149 (50.7%)		
	Seldom	5 (15.2%)	11 (22.4%)	22 (17.5%)	15 (17.4%)	53 (18.0%)		
2019		**SoWD (n = 94)**		**WaSaD (n = 196)**			**Shift type effect**	
		Fixed night (n = 36)	**Fixed early morning (n = 58)**	**Fixed daytime (n = 117)**	**Rotating (n = 79)**	**Total (n = 290)**	χ^2	*p*
Upper limbs above shoulders	Very Frequent	21 (58.3%)	21 (36.2%)	26 (22.2%)	24 (30.4%)	92 (31.7%)	19.844	0.003 *
	Sometimes	13 (36.1%)	31 (53.4%)	70 (59.8%)	39 (49.4%)	153 (52.8%)		
	Seldom	2 (5.6%)	6 (10.3%)	21 (17.9%)	16 (20.3%)	45 (15.5%)		
Trunk Flexion	Very Frequent	20 (55.6%)	19 (32.8%)	26 (22.2%)	25 (31.6%)	90 (31.0%)	16.400	0.011 *
	Sometimes	14 (38.9%)	32 (55.2%)	71 (60.7%)	39 (49.4%)	156 (53.8%)		
	Seldom	2 (5.6%)	7 (12.1%)	20 (17.1%)	15 (19.0%)	44 (15.2%)		
Trunk rotation	Very Frequent	20 (55.6%)	17 (29.3%)	28 (23.9%)	28 (35.4%)	93 (32.1%)	15.740	0.015 *
	Sometimes	15 (41.7%)	31 (53.4%)	70 (59.8%)	37 (46.8%)	153 (52.8%)		
	Seldom	1 (2.8%)	10 (17.2%)	19 (16.2%)	14 (17.7%)	44 (15.2%)		

* $p < 0.05$.

The frequency of discomfort related to environmental conditions was higher among night and early morning shift workers. The differences among shift types were statistically significant in both data collection moments for all the categories assessed (noise, vibrations, temperature) (Table 4).

Table 4. Perception of environmental discomfort (Frequency (%)) in 2017 and 2019 by shift type and results of Chi-square test for homogeneity comparing shift types.

2017		**SoWD (n = 82)**		**WaSaD (n = 212)**			**Shift type effect**	
		Fixed night (n = 33)	**Fixed early morning (n = 49)**	**Fixed daytime (n = 126)**	**Rotating (n = 86)**	**Total (n = 294)**	χ^2	p
Noise	Low discomfort	8 (24.2%)	2 (4.1%)	38 (30.2%)	17 (19.8%)	65 (22.1%)	43.924	<0.001 *
	Moderate	9 (27.3%)	11 (22.4%)	47 (37.3%)	48 (55.8%)	115 (39.1%)		
	High discomfort	16 (48.5%)	36 (73.5%)	41 (32.5%)	21 (24.4%)	114 (38.8%)		
Vibrations	Low discomfort	7 (21.2%)	3 (6.1%)	39 (31.0%)	16 (18.6%)	65 (22.1%)	49.003	<0.001 *
	Moderate	9 (27.3%)	11 (22.4%)	47 (37.3%)	52 (60.5%)	119 (40.5%)		
	High discomfort	17 (51.5%)	35 (71.4%)	40 (31.7%)	18 (20.9%)	110 (37.4%)		
Temperature at Summer	Low discomfort	5 (15.2%)	2 (4.1%)	29 (23.0%)	12 (14.0%)	48 (16.3%)	44.645	<0.001 *
	Moderate	10 (30.3%)	10 (20.4%)	56 (44.4%)	52 (60.5%)	128 (43.5%)		
	High discomfort	18 (54.5%)	37 (75.5%)	41 (32.5%)	22 (25.6%)	118 (40.1%)		
Temperature at Winter	Low discomfort	5 (15.2%)	2 (4.1%)	30 (23.8%)	13 (15.1%)	50 (17.0%)	39.443	<0.001 *
	Moderate	9 (27.3%)	11 (22.4%)	54 (42.9%)	49 (57.0%)	123 (41.8%)		
	High discomfort	19 (57.6%)	36 (73.5%)	42 (33.3%)	24 (27.9%)	121 (41.2%)		
2019		**SoWD (n = 94)**		**WaSaD (n = 196)**			**Shift type effect**	
		Fixed night (n = 36)	**Fixed early morning (n = 58)**	**Fixed daytime (n = 117)**	**Rotating (n = 79)**	**Total (n = 290)**	χ^2	p
Noise	Low discomfort	6 (16.7%)	5 (8.6%)	34 (29.1%)	14 (17.7%)	59 (20.3%)	28.085	<0.001 *
	Moderate	14 (38.9%)	17 (29.3%)	46 (39.3%)	44 (55.7%)	121 (41.7%)		
	High discomfort	16 (44.4%)	36 (62.1%)	37 (31.6%)	21 (26.6%)	110 (37.9%)		
Vibrations	Low discomfort	6 (16.7%)	6 (10.3%)	34 (29.1%)	13 (16.5%)	59 (20.3%)	34.165	<0.001 *
	Moderate	13 (36.1%)	16 (27.6%)	47 (40.2%)	48 (60.8%)	124 (42.8%)		
	High discomfort	17 (47.2%)	36 (62.1%)	36 (30.8%)	18 (22.8%)	107 (36.9%)		
Temperature at Summer	Low discomfort	3 (8.3%)	5 (8.6%)	26 (22.2%)	11 (13.9%)	45 (15.5%)	29.150	<0.001 *
	Moderate	17 (47.2%)	15 (25.9%)	54 (46.2%)	46 (58.2%)	132 (45.5%)		
	High discomfort	16 (44.4%)	38 (65.5%)	37 (31.6%)	22 (27.8%)	113 (39.0%)		
Temperature at Winter	Low discomfort	3 (8.3%)	5 (8.6%)	28 (23.9%)	12 (15.2%)	48 (16.6%)	26.426	<0.001 *
	Moderate	16 (44.4%)	16 (27.6%)	51 (43.6%)	44 (55.7%)	127 (43.8%)		
	High discomfort	17 (47.2%)	37 (63.8%)	38 (32.5%)	23 (29.1%)	115 (39.7%)		

* $p < 0.05$.

3.3. *Psychosocial Determinants of Work Activity*

In 2017, the perceptions of the psychosocial demands related to work activity were statistically different among shift types for cognitive demands, horizontal trust, and meaning of work. Cognitive demands were higher in both shift types of WaSaD, with differences between the early morning (06:00–13:00) and the day shift (08:00–16:00). The worst values of horizontal trust were perceived by the night shift (23:00–06:00) and rotating shift workers, with differences between the night and the early morning shifts. Night shift workers showed better results in terms of the meaning of work, and differed from the early morning shift. In 2019, for job satisfaction, there were differences between shifts: those belonging to the rotating shift had the best results, with significant differences between them and the early morning shift (Table 5).

Table 5. Mean (SD) of psychosocial variables in 2017 and 2019 by shift type, and shift type comparisons.

2017	**SoWD (n = 82)**		**WaSaD (n = 212)**			**Shift Type Effect**	
COPSOQ [g]	**Fixed Night (n = 33)**	**Fixed Early Morning (n = 51)**	**Fixed Daytime (n = 127)**	**Rotating (n = 89)**	**Total (n = 294)**	***F* or *H* Statistic**	***p***
Cognitive demands	2.65 (0.68)	2.61 (0.44)	2.85 (0.53)	2.76 (0.53)	2.76 (0.54)	2.978 [a,c]	0.032 *
Horizontal trust	2.45 (0.66)	2.27 (0.48)	2.32 (0.52)	2.43 (0.59)	2.36 (0.56)	3.081 [a,d]	0.028 *
Offensive behaviors	2.59 (0.80)	2.54 (0.56)	2.74 (0.66)	2.58 (0.61)	2.64 (0.65)	2.651 [b]	0.052
COPSOQ [h]							
Social support from colleagues	2.78 (0.44)	2.78 (0.38)	2.72 (0.44)	2.78 (0.40)	2.75 (0.42)	1.987 [a]	0.116
Auto-efficacy	2.83 (0.76)	2.39 (0.41)	2.47 (0.50)	2.58 (0.61)	2.53 (0.57)	0.091 [a]	0.965
Meaning of work	3.14 (0.63)	2.89 (0.36)	2.82 (0.55)	2.83 (0.44)	2.87 (0.51)	3.705 [b,d]	0.014 *
Job satisfaction	2.59 (0.80)	2.54 (0.56)	2.74 (0.66)	2.58 (0.61)	2.64 (0.65)	1.890 [b]	0.135
2019	**SoWD (n = 94)**		**WaSaD (n = 196)**			**Shift type effect**	
COPSOQ [g]	**Fixed night (n = 36)**	**Fixed early morning (n = 58)**	**Fixed daytime (n = 117)**	**Rotating (n = 79)**	**Total (n = 290)**	***F* or *H* statistic**	***p***
Cognitive demands	2.68 (0.67)	2.64 (0.50)	2.86 (0.51)	2.72 (0.57)	2.76 (0.55)	2.789 [a,e]	0.041 *
Horizontal trust	2.70 (0.32)	2.81 (0.42)	2.77 (0.38)	2.70 (0.36)	2.75 (0.38)	1.381 [a]	0.249
Offensive behaviors	1.04 (0.18)	1.01 (0.07)	1.07 (0.26)	1.07 (0.28)	1.06 (0.23)	3.085 [b,e]	0.030 *
COPSOQ [h]							
Social support from colleagues	2.46 (0.45)	2.43 (0.37)	2.52 (0.43)	2.47 (0.39)	2.48 (0.41)	0.768 [a]	0.513
Auto-efficacy	2.89 (0.86)	2.93 (0.70)	2.92 (0.73)	2.88 (0.74)	2.91 (0.74)	0.080 [a]	0.971
Meaning of work	2.29 (0.65)	2.07 (0.61)	2.32 (0.64)	2.33 (0.64)	2.27 (0.64)	2.320 [a]	0.076
Job satisfaction	2.32 (0.64)	2.13 (0.58)	2.39 (0.62)	2.46 (0.68)	2.35 (0.64)	3.325 [a,f]	0.020 *

[a] ANOVA. [b] ANOVA with Welch correction. [c] Tukey multiple comparisons tests showed significant differences between fixed early morning and fixed daytime shift types ($p = 0.041$). [d] Multiple comparisons tests showed significant differences between fixed night and fixed early morning shift types ($p = 0.040$ in the Tukey test for horizontal trust variable and $p = 0.021$ in the Games–Howell test for meaning of work variable). [e] Multiple comparisons tests (Tukey test for cognitive demands variable and Games–Howell test for offensive behaviors variable) did not identify significant differences. [f] Tukey multiple comparisons tests showed significant differences between fixed early morning and rotating shift types ($p = 0.015$). [g] COPSOQ scales where the higher value is unfavorable. [h] COPSOQ scales where the lower value is unfavorable. * $p < 0.05$.

3.4. Perception of Health and Sleep Disturbances

The perception of health had poorer results in 2017: workers with fixed night and early morning shifts presented worse results when compared to those on the day shifts and rotating shifts. In 2019, the perception of health improved, and the differences between the shifts were no longer statistically significant. The perception of sleep disturbances was higher among workers with fixed night and early morning shifts, when compared to those on the day shifts and rotating shifts, and the differences were statistically significant in both data collection moments. The perception of fatigue after each shift was higher in 2017, but statistically significant differences between shift types were found only in 2019 (Table 6).

Table 6. Mean (SD) for general health, fatigue perception and sleep disturbances variables in 2017 and 2019 by shift type and shift types comparisons.

2017	**SoWD (n = 82)**		**WaSaD (n = 212)**			**Shift Type Effect**	
	Fixed Night (n = 33)	**Fixed Early Morning (n = 49)**	**Fixed Daytime (n = 126)**	**Rotating (n = 86)**	**Total (n = 294)**	***F***	***p***
General health [g]	3.24 (0.71)	3.29 (0.65)	2.95 (0.69)	3.07 (0.75)	3.07 (0.71)	3.370 [a,b]	0.019 *
Sleep disturbances [g]	3.58 (1.08)	3.09 (1.03)	2.36 (0.93)	2.40 (0.92)	2.63 (1.05)	19.100 [a,c]	<0.001 *
Fatigue perception	6.55 (1.28)	6.82 (1.32)	7.10 (1.28)	7.17 (1.47)	7.01 (1.36)	2.276 [a]	0.080
2019	**SoWD (n = 94)**		**WaSaD (n = 196)**			**Shift type effect**	
	Fixed night (n = 36)	**Fixed early morning (n = 58)**	**Fixed daytime (n = 117)**	**Rotating (n = 79)**	**Total (n = 290)**	***F***	***p***
General health [g]	2.61 (1.23)	2.07 (1.23)	2.38 (1.04)	2.38 (1.09)	2.35 (1.12)	1.602 [d]	0.193
Sleep disturbances [g]	3.46 (1.04)	3.03 (1.00)	2.36 (0.92)	2.46 (0.91)	2.66 (1.02)	14.801 [d,e]	<0.001 *
Fatigue perception	3.67 (0.89)	2.97 (1.06)	2.35 (0.92)	2.46 (0.92)	2.67 (1.04)	22.256 [d,f]	<0.001 *

[a] ANOVA. [b] Tukey multiple comparisons test showed significant differences between fixed early morning and fixed daytime shift types ($p = 0.027$). [c] Tukey multiple comparisons tests showed significant differences between fixed night and fixed daytime, fixed night and rotating, fixed early morning and fixed daytime, and fixed early morning and rotating shift types ($p < 0.001$ in all comparisons). [d] ANOVA with Welch correction. [e] Games–Howell multiple comparisons tests showed significant differences between fixed night and fixed daytime ($p < 0.001$), fixed night and rotating ($p < 0.001$), fixed early morning and fixed daytime ($p < 0.001$), and fixed early morning and rotating shift types ($p = 0.005$). [f] Games–Howell multiple comparisons tests showed significant differences between fixed night and early morning ($p = 0.005$), fixed night and rotating ($p < 0.001$), fixed night and fixed daytime ($p < 0.001$), fixed early morning and fixed daytime ($p = 0.002$), and fixed early morning and rotating shift types ($p = 0.020$) (There were no significant differences in fatigue perception between the two WaSaD shift types). [g] COPSOQ scales where the higher value is unfavorable. * $p < 0.05$.

3.5. Predictors of Sleep Disturbances

The stepwise linear regression results concerning the dependent variable sleep disturbance in each data collection moment allowed us to identify the predictors: shift type, trunk flexion, work seniority, horizontal trust, social support from colleagues and auto-efficacy in 2017 ($F(9284) = 10.111$, $p < 0.001$; $R^2 = 0.243$ and adjusted $R^2 = 0.219$); shift type and trunk rotation in 2019 ($F(5284) = 11.315$, $p < 0.001$; $R^2 = 0.166$ and adjusted $R^2 = 0.151$). The multiple linear regression model results are shown in Table 7.

Table 7. Multiple linear regression model results for the dependent variable sleep disturbance in 2017 and 2019.

Predictors in 2017	**Unstandardized Coefficients**		***t***	***p***	**95% CI for B**
	B	**Std Error**			
Intercept	3.495	0.611	5.724	<0.001	(2.293, 4.697)
Shift type (Fixed night) [a]	0.989	0.198	4.994	<0.001	(0.599, 1.379)
Shift type (Fixed early morning) [a]	0.616	0.176	3.488	0.001	(0.268, 0.963)
Shift type (Fixed daytime) [a]	−0.013	0.131	−0.095	0.924	(−0.271, 0.246)
Trunk flexion (Very Frequent) [b]	0.423	0.166	2.556	0.011	(0.097, 0.749)
Trunk flexion (Sometimes) [b]	0.247	0.149	1.654	0.099	(−0.047, 0.541)
Work seniority	−0.015	0.005	−2.732	0.007	(−0.025, −0.004)
Horizontal trust	−0.524	0.156	−3.352	0.001	(−0.831, −0.216)
Social support from colleagues	0.336	0.131	2.557	0.011	(0.077, 0.594)
Auto-efficacy	−0.175	0.083	−2.118	0.035	(−0.338, −0.012)

Table 7. *Cont.*

Predictors in 2019	Unstandardized Coefficients		*t*	*p*	95% CI for B
	B	Std Error			
Intercept	2.189	0.167	13.144	<0.001	(1.861, 2.517)
Shift type (Fixed night) [a]	0.924	0.192	4.816	<0.001	(0.547, 1.302)
Shift type (Fixed early morning) [a]	0.582	0.163	3.564	<0.001	(0.260, 0.903)
Shift type (Fixed daytime) [a]	−0.082	0.138	−0.591	0.555	(−0.354, 0.190)
Trunk rotation (Very Frequent) [b]	0.437	0.176	2.483	0.014	(0.090, 0.783)
Trunk rotation (Sometimes) [b]	0.246	0.162	1.520	0.130	(−0.073, 0.565)

[a] The reference category for the predictor shift time is rotating shift. [b] The reference category for the predictor trunk rotation is seldom

4. Discussion

This study showed an ageing trend in the SMAS of the Sintra municipality, similar to many other sectors in the public administration in Portugal and other European countries [10,13]. A rising mean age arose in the four types of shifts in the two divisions. The results forewarn of the challenge of matching the changes that emerge from the ageing processes to the demands of tasks and shift work in the water, sanitation and waste sector. Workers on permanent night and early morning shifts showed a mean age of around 48 years in 2017 and 50 in 2019. The difficulties that older workers face when coping with night shifts or early morning shifts [14] mainly result in decreased performance and subjective sleepiness [15], although the evidence regarding the increase in shiftwork problems with age may not be clear [9]. Some studies report that being older might be beneficial for shift work tolerance [14].

Experience may constitute an advantage for older shift workers, showing better strategies to manage shiftwork demands [16]. In the present study, both permanent night and early morning shifts presented workers with lower seniority. These results point to a perspective of changing trajectories in working life regarding shiftwork: it seems that there is a drive from night and early morning fixed shifts to daytime and rotating shifts. The changes in shift patterns align with the benefits that fast forward rotating shifts have demonstrated concerning improved sleep, better health, and social benefits [17]. In this sector it has been hard to recruit new workers for night and early morning shifts, and, some years later, part of them require a change to a daytime shift. This tendency may not be clearly identified in a two-year period, making longitudinal studies essential.

The perception of work demands was also different among the types of shifts: those from SoWD perform night and early morning shifts and perceive work as mainly physical; those from WaSaD perform fixed daytime or rotating shifts and perceive work as both mental and physical. It appears that, in daytime shifts, more interaction with colleagues or the public leads to higher mental demands. Additionally, during the daytime, shift supervisors with a higher number of teams to coordinate allocate more responsibilities to workers. These aspects have emerged through cognitive demands perceived with higher values in daytime shifts. Regarding postural demands, having the upper limbs above the shoulders and a flexed trunk showed statistically significant differences between shift types, with the highest frequency in the night shift. This profile appeared in the two data collection moments, indicating higher postural demands among those working the night shift. Some physically demanding tasks are performed during the night shift, such as collecting discharged equipment in urban areas. These tasks are physically demanding and determine the adoption of awkward postures and manual handling. Higher job demands, namely, intense physical work and tiring postures, are related to the onset of sleep disturbances and impairments [18–20].

Adverse environmental conditions, such as exposure to noise, vibrations and heat stress, have been found to increase the risk of sleep disturbances [5,21,22]. Noise exposure has adverse effects on the quantity and quality of sleep [21,22], but cumulative exposure to vibrations may cause a synergistic effect increasing sleep disruptions [21]. In our study, the perception of high levels of discomfort regarding the exposure to vibrations and noise was higher in the group working on the early morning shift, followed by those on the night shift. Regarding heat stress, exposure to this environmental risk factor may increase the risk of sleep disturbances [5]. Environmental risk factors may contribute to a higher probability of increased sleep disturbances in the groups working during the night and early morning shifts, but these variables did not appear as predictors in the regression model.

Psychosocial factors are related to the quality and quantity of sleep, and several studies show associations of job control, social support and meaning of work with quality or quantity of sleep, although some findings might be inconsistent [4,23,24]. The cognitive demands are mainly related to memory requests, the need for problem solving and giving new ideas during work activity [24]. In both data collection moments, these seemed to be more relevant during fixed daytime shifts. When these demands are too high, the negative impact on stress perception contributes to a disrupted sleep [4,23,24]. The meaning of work showed differences between those on permanent night and early morning shifts, with the best values were seen among the night shift group, in 2017. These differences did not appear in 2019. A meaningful working life is a relevant variable positively influencing sleep quality [23]. Regarding horizontal trust in 2017, worse results were perceived by those on the night shift. These workers do not meet other groups from other departments because they work permanently from 24:00 till 8:00. This might influence their perception of trust or support from other departments or divisions. Social support contributes to a reduction in sleep troubles [23], playing a relevant role in the management of the impact of shift work. Social support may act as a buffer to high work demands or low degree of control, protecting against the effects of night shift work [4]. In 2019, job satisfaction showed negative results within the group working the early morning shift. Different activity sectors showed an association between job satisfaction and sleep quality, which was more evident in daytime shifts [25]. Actually, the relationship between job satisfaction and sleep quality may depend on the shift, considering that workers on night and early morning shifts are more used to poor sleep quality [25]. Among dissatisfied workers, an increase in stress levels may negatively influence health and sleep [26]. From 2017 to 2019, SMAS faced organizational changes with a strategy that emphasized the acquisition of new pieces of equipment for daytime shifts, which may have impacted the overall perception of rewards and recognition in some areas. This may explain the rising dissatisfaction among those on the early morning shift, but the interpretation must be cautious because satisfaction is a multifactorial construct.

It is well established that environmental exposures and physical and psychosocial work factors influence the quality and quantity of sleep. In the present study, sleep disturbances were perceived more negatively by those working permanent night and early morning shifts. The main differences were identified between those two types of shifts and the rotating and fixed daytime shifts, meaning that different types and fixed shifts have a distinct impact on sleep disturbances. These findings are in agreement with the literature stressing that night shifts are more problematic in relation to sleep disturbances [2,3,8]. Contrastingly, some studies focusing on permanent night shifts point to an improvement in individual adaptability [26]. This may be the case for some workers on night shifts, considering the average ages and the higher seniority (>15 years) of these workers (24%).

In modern societies, sleep problems are common in occupational groups, with negative consequences for health [27]. No sleep disturbances between 50 and 70 years of age is associated with a long, healthy life [27]. So, identifying the main predictors of sleep disturbances is relevant to defining specific measures that prevent negative effects on the health and well-being of these workers. It is also relevant to identify the profiles of susceptible workers that will benefit from support strategies offered by the organization. Our regression models reveal that, in 2017 and 2019, shift type was one of the main predictors of sleep disturbances: working in permanent night or early morning shifts was the main determinant of sleep disturbances, which is in accordance with the literature [2,28–30]. The presence of high physical demands, such as the adoption of awkward postures, was a predictor of sleep disturbances. Some authors related intense physical work and tiring postures with the inception of sleep disturbances [6,18]. In 2017, work seniority, horizontal trust and auto-efficacy were protective factors contributing to decreasing sleep disturbances. The role of work seniority can be understood from two perspectives: regarding the possible ability of some of these workers to adapt to permanent night shifts [14]; considering the possible pathways in working trajectories from permanent night shifts to day shifts or rotating ones. Horizontal trust, meaning that these workers trust co-workers, studied from the perspective of commitment, has a positive impact on retaining workers in organizations [30]. In our model, horizontal trust is related to lower sleep disturbances. This positive effect can emerge from increased group cohesion resulting from better trust [30] and social support, which prevents sleep troubles [23]. Auto-efficacy also appeared as a protective factor. It is related to the belief in the ability to perform actions required in certain situations, and is a key factor in engagement in effortful tasks [31]. Although there is no consensus regarding the influence of auto-efficacy and personality-related variables on shift work tolerance [14], some studies showed a positive relationship between internal locus of control and shiftwork tolerance [32]. In 2019, these protective factors did not appear in the model, while the participants were the same. Organizational changes that occurred in the period between the two data collection moments may have influenced the perception of workers of horizontal trust and social support from colleagues.

Some limitations of this study are related to the different tasks performed in the two divisions, involving different levels of physical or mental demands, possibly acting as confounders concerning shiftwork effects, and making comparisons more difficult. Another limitation results from the self-reported questionnaires and the possibility of recall bias. Recall bias is very plausible in the variable of seniority and others. Furthermore, a self-selection process is typical in shift work, and is likely to result in a healthy worker effect [14]. Finally, the proportion of the total variance of sleep disturbance explained by the multiple linear regression models was low in both data collection moments, which indicates that the variables considered in the study did not explain a substantial part of the total variance of the sleep disturbance.

5. Conclusions

The study was centered on workers from the water, sanitation and waste sector, an active sector essential to urban life. As these workers are less focused on research, the results are valuable to establishing prevention measures and enabling future research.

It was possible to identify different profiles based on the types of shifts: an ageing population in all shift types; possible occupational trajectories changing from permanent night and early morning shifts to daytime and fast rotating shifts; differences between permanent night and early morning shifts when compared with daytime and fast rotating ones. Workers on fixed night and early morning shifts perceived higher postural demands and environmental discomfort, and lower social support or job dissatisfaction. Workers in daytime or fast rotating shifts perceived higher cognitive demands.

Among those working on permanent night and early morning shifts, the perception of sleep disturbances was more negative. The main predictors were the types of shifts and the intense physical demands in 2017 and 2019. Protective factors were identified in the model only in 2017, and included horizontal trust and auto-efficacy.

These results should guide the organization through the definition of a prevention plan to minimize the negative effects of exposure to shift work, namely, to permanent night and early morning shifts. Although there are no optimal solutions for night work, the prevention measures should consider a participatory model that includes the family and social preferences of shift workers, demographic changes in the workforce, and workers' health, safety and performance indicators. The identification of work determinants related to the inception of sleep disorders underlines the relevance of management strategies for environmental, physical and psychosocial risk factors for sleep disorder prevention.

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References

1. Mendes, P.; Santos, A.C.; Perna, F.; Teixeira, M.R. The balanced scorecard as an integrated model applied to the Portuguese public service: A case study in the waste sector. *J. Clean. Prod.* **2012**, *24*, 20–29. [CrossRef]
2. Arendt, J. Shift work: Coping with the biological clock. *Occup. Med.* **2010**, *60*, 10–20. [CrossRef] [PubMed]
3. Åkerstedt, T.; Fredlund, P.; Gillberg, M.; Jansson, B. Work load and work hours in relation to disturbed sleep and fatigue in a large representative sample. *J. Psychosom. Res.* **2002**, *53*, 585–588. [CrossRef]
4. Åkerstedt, T.; Garefelt, J.; Richter, A.; Westerlund, H.; Magnusson Hanson, L.L.; Sverke, M.; Kecklund, G. Work and Sleep—A prospective study of psychosocial work factors, physical work factors and work schedulling. *Sleep* **2015**, *38*, 1129–1135. [CrossRef]
5. Mokarami, H.; Gharibi, V.; Kalteh, H.O.; Kujerdi, M.F.; Kazemi, R. Multiple environmental and psychosocial work risk factors and sleep disturbances. *Int. Arch. Occup. Environ. Health* **2020**, *93*, 623–633. [CrossRef] [PubMed]
6. Parkes, K.R. Age and work environment characteristics in relation to sleep: Additive, interactive and curvilinear effects. *Appl. Ergon.* **2016**, *54*, 41–50. [CrossRef] [PubMed]
7. Vleeshouwers, J.; Knardahl, S.; Christensen, J.O. Effects of psychological and social work factors on self-reported sleep disturbance and difficulties initiating sleep. *Sleep* **2016**, *39*, 833–846. [CrossRef] [PubMed]
8. Flo, E.; Pallesen, S.; Åkerstedt, T.; Magerøy, N.; Moen, B.E.; Grønli, J.; Nordhus, I.H.; Bjorvatn, B. Shift-related sleep problems vary according to work schedule. *Occup. Environ. Med.* **2013**, *70*, 238–245. [CrossRef]
9. Blok, M.M.; de Looze, M.P. What is the evidence for less shift work tolerance in older workers? *Ergonomics* **2011**, *54*, 221–232. [CrossRef]
10. Cotrim, T.P.; Ribeiro, C.; Teles, J.; Reis, V.; Guerreiro, M.J.; Janicas, A.S.; Candeias, S.; Costa, M. Monitoring work ability index during a two-year period among Portuguese municipality workers. *Int. J. Environ. Res. Public Health* **2019**, *16*, 3674. [CrossRef]
11. Lazzari, M.A.; Reis, C.B. Os coletores de lixo urbano no município de Dourados (MS) e sua percepção sobre os riscos biológicos em seu processo de trabalho. *Cienc. Saude Coletiva* **2011**, *16*, 3437–3442. [CrossRef]
12. Silva, C.; Amaral, V.; Pereira, A.; Bem-Haja, P.; Pereira, A.; Rodrigues, V.; Cotrim, T.; Silvério, J.; Nossa, P. *Copenhagen Psychosocial Questionnaire-COPSOQ-Portugal e Países Africanos de Língua Oficial Portuguesa*, 1st ed.; Universidade de Aveiro: Aveiro, Portugal, 2012.
13. Kulmala, J.; von Bonsdorff, M.; Stenholm, S.; Törmäkangas, T.; Nygård, C.-H.; Klockars, M.; Seitsamo, J.; Ilmarinen, J.; Rantanen, T. Perceived stress symptoms in midlife predict disability in old age: A 28-year prospective cohort study. *J. Gerontol.-Ser. A Biol. Sci. Med. Sci.* **2013**, *68*, 984–991. [CrossRef] [PubMed]
14. Saksvik, I.B.; Bjorvatn, B.; Hetland, H.; Sandal, G.M.; Pallesen, S. Individual differences in tolerance to shift work—A systematic review. *Sleep Med. Rev.* **2011**, *15*, 221–235. [CrossRef] [PubMed]
15. Bonnefond, A.; Härmä, M.; Hakola, T.; Sallinen, M.; Kandolin, I.; Virkkala, J. Interaction of age with shift-related sleep-wakefulness, sleepiness, performance, and social life. *Exp. Aging Res.* **2006**, *32*, 185–208. [CrossRef] [PubMed]
16. Costa, G. Some considerations about aging, shift work and work ability. *Int. Congr. Ser.* **2005**, *1280*, 67–72. [CrossRef]
17. Karhula, K.; Hakola, T.; Koskinen, A.; Lallukka, T.; Ojajärvi, A.; Puttonen, S.; Oksanen, T.; Rahkonen, O.; Ropponen, A.; Härmä, M. Ageing shift workers' sleep and working-hour characteristics after implementing ergonomic shift-scheduling rules. *J. Sleep Res.* **2021**, *30*, e13227. [CrossRef]
18. Åkerstedt, T.; Nordin, M.; Alfredsson, L.; Westerholm, P.; Kecklund, G. Predicting changes in sleep complaints from baseline values and changes in work demands, work control, and work preoccupation—The WOLF-project. *Sleep Med.* **2012**, *13*, 73–80. [CrossRef]
19. Hämmig, O.; Bauer, G.F. Work, work-life conflict and health in an industrial work environment. *Occup. Med.* **2014**, *64*, 34–38. [CrossRef]

20. Azadboni, Z.D.; Talarposhti, R.J.; Ghaljahi, M.; Mehri, A.; Aarabi, S.; Poursadeghiyan, M.; Abbasi, M. Effect of occupational noise exposure on sleep among workers of textile industry. *J. Clin. Diagn. Res.* **2018**, *12*, LC18–LC21. [CrossRef]
21. Nari, F.; Kim, Y.K.; Kang, S.H.; Park, E.C.; Jang, S.I. Association between occupational noise and vibration exposure and insomnia among workers in Korea. *Life* **2020**, *10*, 46. [CrossRef]
22. Heo, Y.-S.; Chang, S.-J.; Park, S.-G.; Leem, J.-H.; Jeon, S.-H.; Lee, B.-J.; Rhee, K.-Y.; Kim, H.-C. Association between Workplace Risk Factor Exposure and Sleep Disturbance: Analysis of the 2nd Korean Working Conditions Survey. *Ann. Occup. Environ. Med.* **2013**, *25*, 41. [CrossRef] [PubMed]
23. Murata, C.; Yatsuya, H.; Tamakoshi, K.; Otsuka, R.; Wada, K.; Toyoshima, H. Psychological factors and insomnia among male civil servants in Japan. *Sleep Med.* **2007**, *8*, 209–214. [CrossRef]
24. Burr, H.; Berthelsen, H.; Moncada, S.; Nübling, M.; Dupret, E.; Demiral, Y.; Oudyk, J.; Kristensen, T.S.; Llorens, C.; Navarro, A.; et al. The Third Version of the Copenhagen Psychosocial Questionnaire. *Saf. Health Work* **2019**, *10*, 482–503. [CrossRef]
25. Chang, W.P.; Chang, Y.P. Relationship between job satisfaction and sleep quality of female shift-working nurses: Using shift type as moderator variable. *Ind. Health* **2019**, *57*, 732–740. [CrossRef] [PubMed]
26. Kazemi, R.; Motamedzade, M.; Golmohammadi, R.; Mokarami, H.; Hemmatjo, R.; Heidarimoghadam, R. Field Study of Effects of Night Shifts on Cognitive Performance, Salivary Melatonin, and Sleep. *Saf. Health Work* **2018**, *9*, 203–209. [CrossRef] [PubMed]
27. Stenholm, S.; Head, J.; Kivimaki, M.; Hanson, L.L.M.; Pentti, J.; Rod, N.H.; Clark, A.J.; Oksanen, T.; Westerlund, H.; Vahtera, J. Sleep Duration and Sleep Disturbances as Predictors of Healthy and Chronic Disease-Free Life Expectancy between Ages 50 and 75: A Pooled Analysis of Three Cohorts. *J. Gerontol.-Ser. A Biol. Sci. Med. Sci.* **2019**, *74*, 204–210. [CrossRef]
28. Åkerstedt, T. Shift work and disturbed sleep/wakefulness. *Occup. Med.* **2003**, *53*, 89–94. [CrossRef]
29. Axelsson, J.; Åkerstedt, T.; Kecklund, G.; Lowden, A. Tolerance to shift work—How does it relate to sleep and wakefulness? *Int. Arch. Occup. Environ. Health* **2004**, *77*, 121–129. [CrossRef]
30. Lewicka, D. Interpersonal Trust at Work and Organisational and Professional Commitment Interdependency Model. *J. Posit. Manag.* **2016**, *6*, 83. [CrossRef]
31. Ein-Gar, D.; Steinhart, Y. Self-control and task timing shift self-efficacy and influence willingness to engage in effortful tasks. *Front. Psychol.* **2017**, *8*, 1788. [CrossRef]
32. Smith, L.; Jeppesen, H.J.; Bøggild, H. Internal locus of control and choice in health service shift workers. *Ergonomics* **2007**, *50*, 1485–1502. [CrossRef] [PubMed]