

Supplemental materials

A multilevel approach to individual and organizational predictors of stress and fatigue among healthcare workers of a university hospital: a longitudinal study

by Oumou Salama Daouda¹, René Sosata Bun, Karim Ait Bouziad, Katiuska Miliani, Anastasia Essaworo, Florence Espinasse, Delphine Seytre, Anne Casetta, Simone Nérome, Adelaide Nascimento, Pascal Astagneau, Laura Temime, Mounia N Hocine

¹ Correspondence concerning this article should be addressed to Ms. Oumou S. Daouda, MESuRS laboratory, Cnam, 292 rue Saint Martin, 75003 Paris, France (email: oumou-salama.daouda@lecnam.net)

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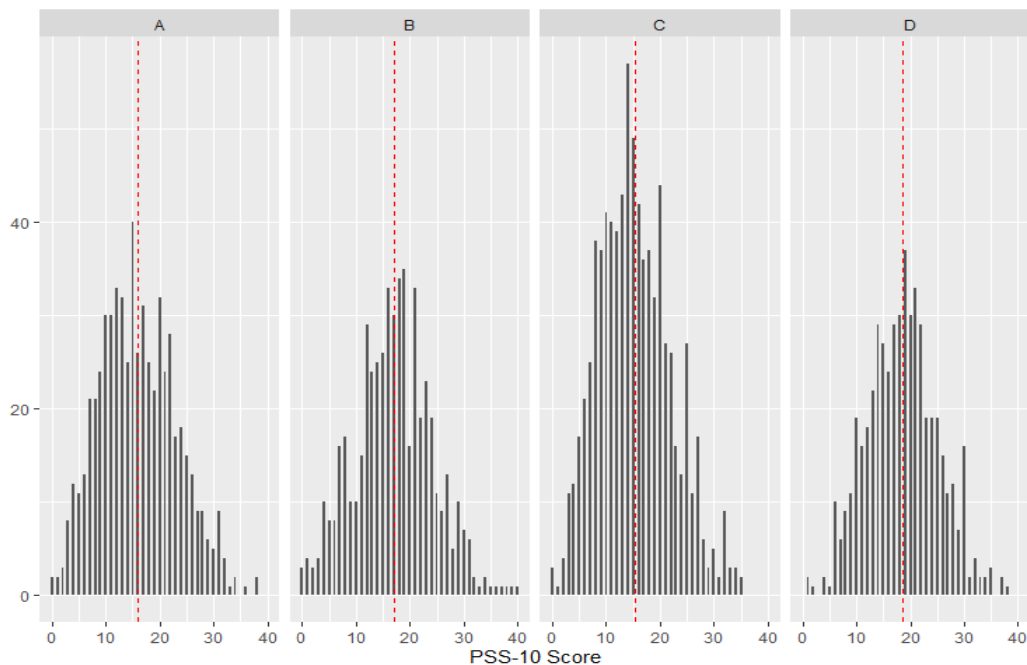
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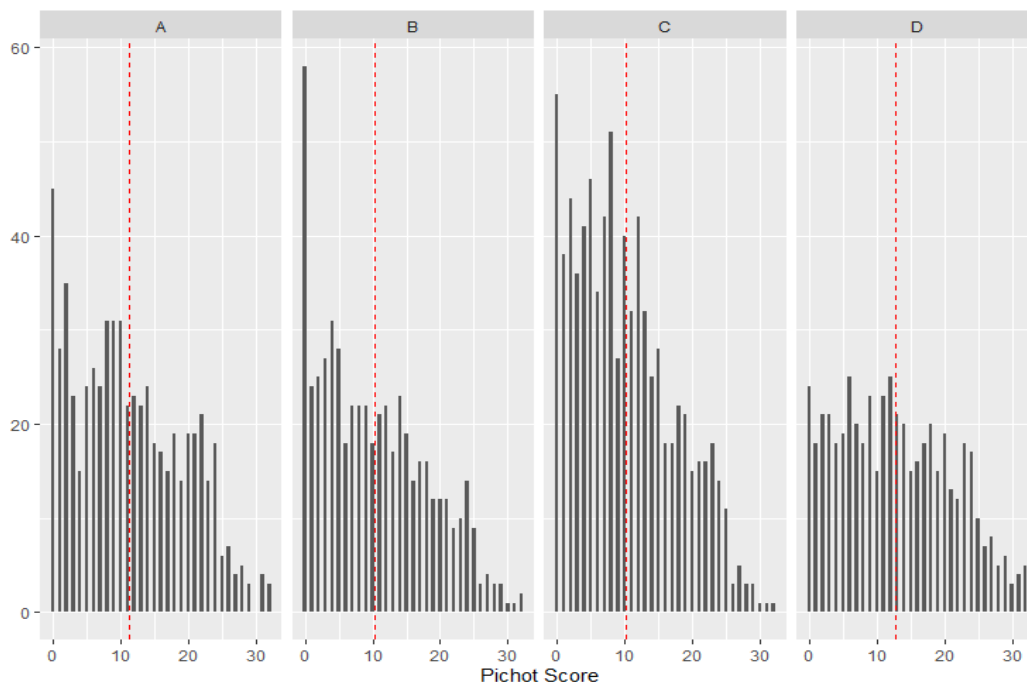
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Supplementary table 1. Characteristics of individuals and missing values at the times of visits (t0, t1, t2 and t3)

Two-sided ANOVA tests were performed for continuous variables and Chi square tests were performed for qualitative variables

	t0 (N=694)	t1 (N=644)	t2 (N=578)	t3 (N=556)	Total (N=2472)	p value
Work schedule of last months						0.636
Daily	458 (66.0%)	436 (67.7%)	381 (65.9%)	357 (64.2%)	1632 (66.0%)	
Nightly	198 (28.5%)	185 (28.7%)	170 (29.4%)	168 (30.2%)	721 (29.2%)	
Day and Night	38 (5.5%)	23 (3.6%)	27 (4.7%)	31 (5.6%)	119 (4.8%)	
Schedule assignment frequency						< 0.001
Mostly	76 (11.0%)	47 (7.3%)	23 (4.0%)	36 (6.5%)	182 (7.4%)	
Always	618 (89.0%)	597 (92.7%)	555 (96.0%)	519 (93.5%)	2289 (92.6%)	
Missing	0	0	0	1	1	
Nightshift/duty on last months						< 0.001
No	564 (81.4%)	380 (59.1%)	324 (56.2%)	319 (57.7%)	1587 (64.4%)	
Yes	129 (18.6%)	263 (40.9%)	252 (43.8%)	234 (42.3%)	878 (35.6%)	
Missing	1	1	2	3	7	
Number of nightshift/duties						< 0.001
Mean (SD)	0.6 (1.7)	1.3 (2.2)	1.5 (2.3)	1.5 (2.4)	1.2 (2.2)	
Missing	4	5	2	3	14	
Work schedule variation						0.762
Never	404 (58.2%)	360 (55.9%)	334 (57.8%)	319 (57.4%)	1417 (57.3%)	
Fairly often	122 (17.6%)	123 (19.1%)	94 (16.3%)	100 (18.0%)	439 (17.8%)	
Almost Never	146 (21.0%)	132 (20.5%)	133 (23.0%)	114 (20.5%)	525 (21.2%)	
Very often	22 (3.2%)	29 (4.5%)	17 (2.9%)	23 (4.1%)	91 (3.7%)	
Overtime hours						0.098
Never	238 (34.3%)	209 (32.5%)	177 (30.6%)	179 (32.2%)	803 (32.5%)	
Fairly often	205 (29.5%)	209 (32.5%)	208 (36.0%)	189 (34.0%)	811 (32.8%)	
Almost Never	173 (24.9%)	180 (28.0%)	149 (25.8%)	139 (25.0%)	641 (25.9%)	

Very often	78 (11.2%)	46 (7.1%)	44 (7.6%)	49 (8.8%)	217 (8.8%)	
Irregularity of meal time						0.047
Never	41 (5.9%)	51 (7.9%)	34 (5.9%)	37 (6.7%)	163 (6.6%)	
Fairly often	191 (27.6%)	182 (28.3%)	188 (32.5%)	175 (31.5%)	736 (29.8%)	
Almost Never	62 (8.9%)	55 (8.5%)	63 (10.9%)	69 (12.4%)	249 (10.1%)	
Very often	399 (57.6%)	356 (55.3%)	293 (50.7%)	275 (49.5%)	1323 (53.5%)	
Missing	1	0	0	0	1	
Number of canceled breaks						< 0.001
Never	48 (6.9%)	75 (11.6%)	67 (11.6%)	65 (11.7%)	255 (10.3%)	
Fairly often	279 (40.2%)	266 (41.3%)	229 (39.6%)	221 (39.7%)	995 (40.3%)	
Almost Never	129 (18.6%)	128 (19.9%)	152 (26.3%)	162 (29.1%)	571 (23.1%)	
Very often	238 (34.3%)	175 (27.2%)	130 (22.5%)	108 (19.4%)	651 (26.3%)	
Number of visits to the Occupational safety and health (OSH) department						< 0.001
Mean (SD)	0.3 (0.5)	0.2 (0.5)	0.1 (0.4)	0.2 (0.5)	0.2 (0.5)	
Personal life events						0.148
No	408 (58.8%)	383 (59.6%)	350 (60.6%)	337 (60.6%)	1478 (59.8%)	
Yes, negative	217 (31.3%)	192 (29.9%)	166 (28.7%)	141 (25.4%)	716 (29.0%)	
Yes, positive	69 (9.9%)	68 (10.6%)	62 (10.7%)	78 (14.0%)	277 (11.2%)	
Missing	0	1	0	0	1	
Professional life events						0.557
No	488 (70.5%)	463 (71.9%)	390 (67.6%)	381 (68.6%)	1722 (69.8%)	
Yes, negative	151 (21.8%)	139 (21.6%)	137 (23.7%)	123 (22.2%)	550 (22.3%)	
Yes, positive	53 (7.7%)	42 (6.5%)	50 (8.7%)	51 (9.2%)	196 (7.9%)	
Missing	2	0	1	1	4	
Sickness presenteeism						0.005
Never	159 (22.9%)	192 (29.9%)	122 (21.1%)	154 (27.7%)	627 (25.4%)	
Fairly often	218 (31.4%)	178 (27.7%)	174 (30.2%)	148 (26.7%)	718 (29.1%)	
Almost Never	275 (39.6%)	242 (37.7%)	251 (43.5%)	235 (42.3%)	1003 (40.6%)	
Very often	42 (6.1%)	30 (4.7%)	30 (5.2%)	18 (3.2%)	120 (4.9%)	
Missing	0	2	1	1	4	
Marital status						0.371

Couple	382 (55.0%)	360 (55.9%)	336 (58.3%)	328 (59.4%)	1406 (57.0%)	
Single	312 (45.0%)	284 (44.1%)	240 (41.7%)	224 (40.6%)	1060 (43.0%)	
Missing	0	0	2	4	6	
Commuting time to work						0.109
<1 h	290 (41.8%)	270 (41.9%)	253 (43.8%)	243 (43.7%)	1056 (42.7%)	
>2h	99 (14.3%)	91 (14.1%)	54 (9.3%)	60 (10.8%)	304 (12.3%)	
1-2 h	305 (43.9%)	283 (43.9%)	271 (46.9%)	253 (45.5%)	1112 (45.0%)	
Support from colleagues						0.476
Mean (SD)	13.2 (2.0)	13.1 (2.0)	13.1 (2.0)	13.0 (2.0)	13.1 (2.0)	
Support from hierarchy						< 0.001
Mean (SD)	11.7 (2.7)	11.5 (2.5)	11.4 (2.6)	11.1 (2.8)	11.4 (2.7)	
Work overcommitment						0.558
Mean (SD)	15.5 (2.7)	15.4 (2.7)	15.3 (2.6)	15.3 (2.6)	15.4 (2.7)	

Supplementary table 2: Means and ranges of outcomes variables (PSS-10 and Pichot scores), by time of visits

	t0 (N=694)	t1 (N=644)	t2 (N=578)	t3 (N=556)	Total (N=2472)	p_value
PSS-10 score						0.126
Mean (SD)	17.0 (7.0)	16.5 (7.0)	16.3 (7.0)	16.2 (7.1)	16.5 (7.0)	
Range	0.0 - 38.0	0.0 - 38.0	1.0 - 40.0	0.0 - 39.0	0.0 - 40.0	
Pichot score						0.028
Mean (SD)	10.4 (7.8)	11.5 (8.0)	10.9 (7.9)	11.4 (7.9)	11.0 (7.9)	
Range	0.0 - 32.0	0.0 - 32.0	0.0 - 32.0	0.0 - 32.0	0.0 - 32.0	

Supplementary table 3: Outcomes (PSS-10 and Pichot scores), and missing values by hospital

	A (N=610)	B (N=538)	C (N=801)	D (N=523)	Total (N=2472)	p_value
PSS-10 score						< 0.001
Mean (SD)	16.0 (7.2)	17.0 (7.2)	15.3 (6.8)	18.6 (6.6)	16.5 (7.0)	
Missing	4	12	2	4	22	
Pichot score						< 0.001
Mean (SD)	11.4 (8.0)	10.3 (7.9)	10.1 (7.3)	12.8 (8.3)	11.0 (7.9)	
Missing	0	0	2	1	3	

Supplementary table 4: Unconditional 2 and 3-level models for outcomes of perceived stress and fatigue

	Stress – PSS-10 Score		Fatigue – Pichot Score	
	2-level	3-level	2-level	3-level
Intercept	16.7(0.23)	16.9 (0.38)	11.2 (0.25)	11.4 (0.5)
Random effects - $\sigma^2(\sigma)^*$				
Level 1 – Time	28.9 (5.3)	20.9 (4.6)	23.9 (4.8)	23.8 (4.9)
Level 2 – Healthcare worker	28.94 (5.3)	25.9 (5.1)	39.12 (6.3)	35.1 (6)
Level 3 – Ward		3.2 (1.8)		4.6 (2.1)
AIC ^a	15762.86	15737.24	15922.34	15896.45
ANOVA test p-value		< 2e-16		2.25 x 10e-07

^a AIC Akaike Information Criterion

Intra-class correlation coefficient (ICC) calculation

Using the 3-levels null models, ICC were computed, in order to quantify how much response variable variance is shared, or correlated, across different combinations of levels. ICC has been defined as “. . . an estimate of the expected (population) correlation between

two randomly chosen elements in the same group” [33]. As such, three different ICCs could be calculated to assess the influence of ward on change in level of stress and fatigue over time.

The level of stress and fatigue variance has been partitioned at all three levels. It can be easily shown that, the PSS-10 score and the Pichot score variations occurred due to temporal fluctuations (level 1, 42% for stress and 37.4% for fatigue), inter-individual heterogeneity (level 2, 52% for stress and 55.5% for fatigue) and ward-level specificities (level 3, 6% for stress and 7.2% for fatigue). In addition, these partitioned variances can be used to compute three different ICCs to assess the influence of ward on change in stress and fatigue level over time.

First, for the stress level, one level 3 ICC already estimated above (0.06), is interpreted as the expected correlation between two stress level drawn completely at random (from any time point), from two healthcare workers within the same service. Second, an alternative level 3 ICC estimate can be calculated as $(3.2 / (3.2+25.9) = 0.11\%)$ and interpreted as the expected correlation between the mean (i.e., averaged across all repeated measures) stress levels from two healthcare workers drawn completely at random from the same service. Finally, a level 2 ICC could also calculate by $(3.2 + 25.9 / (3.2+25.9+20.9) = 0.58)$ and is interpreted as the expected correlation between two repeated measurements sampled from the same healthcare workers. In the same way, 3 ICCs for fatigue are calculated and correspond to 0.07% for ICC level 3, 0.12 for the second ICC level 3 and 0.45 for the ICC level 2.

Supplementary table 5: Summary of missing values according to validated scales, by time of visits

	t0	t1	t2	t3	Total
PSS-10 score - Stress	7	3	5	7	22
Pichot score - Fatigue	1	0	2	0	3
Karasek score - Support from colleagues	6	4	1	1	12
Karasek score - Support from hierarchy	23	5	1	0	29
Siegrist score - Work overcommitment	1	1	0	1	3

In the whole sample (n =2472), high number of missing values were observed on support from the hierarchy and perceived stress, respectively 29 and 22 values. The lowest number of missing values were observed on fatigue and work overcommitment, all two 3 missing values. We count 12 missing values in the whole sample for the support from colleague’s variable. Before proceeding with the 3-levels analyses, missing values were imputed.