Work environment-related factors and nurses’ health outcomes: A cross-sectional study in Lebanese hospitals

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Abstract

Background:

Worldwide, studies show that work environment factors are related with increased health risks among nurses. However, it remains unclear how specific work-related factors relate to certain health outcomes and data investigating allocation of nursing tasks and detailed assessments of self-perceived workload are lacking. Data are particularly lacking for Lebanese nurses. We assessed the relationship of several work environment factors (overall workload and specific temporal, physical, mental, effort, frustration, and performance demands, staffing resources adequacy, leadership, teamwork climate, and allocation of nursing tasks per professional category) with the presence of health problems, including musculoskeletal, cardiovascular, skin, and mental health diseases and emotional exhaustion among Lebanese nurses.

Methods:

Data come from a cross-sectional self-report survey of 289 registered nurses (RNs) working in two university-affiliated hospitals in Lebanon. Adjusted multivariable logistic regression models were used to assess the relationship of work-environment factors with nurses’ health conditions.

Results:

The most prevalent outcomes were musculoskeletal disease (69%), emotional exhaustion (59%), and mental health problems (56%); we found high co-morbidity levels with 70% of RNs having ≥2 and 35.29% having ≥4 co-occurring health problems. There was a widespread pattern of associations between work environment-related factors and musculoskeletal and mental/emotional health problems, with positive associations of higher overall workloads and temporal demands and negative associations of teamwork climate with both musculoskeletal (OR=1.36 (95%CI=1.03, 1.80); 1.30 (95%CI=1.09, 1.55); 0.60 (95%CI=0.36, 0.98), respectively) and mental/emotional health problems (increased risk ranging from 22% to 88%). Higher physical demands and allocation of nursing tasks to the RNs were associated with higher odds of musculoskeletal disease (OR=1.20 (95%CI=1.03, 1.49); 1.11 (95%CI=1.01, 1.23)); more frustration and effort demands and lower performance satisfaction and resources adequacy were related to mental/emotional problems (OR=1.22 (95%CI=1.06, 1.41); 1.26 (95%CI=1.06, 1.49); 0.82 (95%CI=0.70, 0.97); 0.54 (95%CI=0.35, 0.82)). Work-environment factors were also related to a higher co-occurrence of health problems among nurses.

Conclusions:

Results highlight the value of a more comprehensive approach towards improving the work environment of Lebanese nurses (including improving team climate, different components of workload demands, resources, and the allocation of nursing tasks) which can simultaneously improve multiple health risks in this burdened population.
1 Background

Worldwide, accumulated data show that nursing is a demanding and stressful profession (1-3). Nurses work in complex environments, variable and long hour-rotating shifts, and get exposed to a variety of occupational risks and accidents frequently (4-6). Empirical research has shown that nurses suffer from physical illness, mental disorder, and emotional exhaustion more than other health practitioners in the general population (7, 8).

Specifically, musculoskeletal diseases are critical occupational health problems among nurses due to the nature of working conditions and tasks, which involve physical effort and repetitive movement (9, 10). Research from several countries, including Brazil, Italy, Estonia, Uganda, Nigeria, and the United States have reported an annual prevalence of work-related musculoskeletal disorders among nurses ranging between 40% and 85% (11-15). Other health conditions important for this occupation are skin diseases, including eczema, allergy, and fungal infections due to the possibility of exposure to various chemical (e.g., formaldehyde and ethylene oxide), biological (e.g., fungi, viruses, and bacteria), and physical hazards (e.g., radiation, and populous air conditioning) (6, 16). Some results also suggest that nurses might have increased risk of cardiovascular diseases due to their shifts working conditions (17). Reed et al. (2018) found, in a sample of Canadian hospitals, that nurses had several cardiovascular disease risk factors including objectively measured obesity/overweight, hypertension, and high cholesterol level, as well as self-reported poor mental health, smoking, and diabetes status (10). Another prominent health outcomes reported among nurses are mental health problems including anxiety, stress, depression, sleep disorders, and emotional exhaustion (6, 18-22).

In addition to the nature of the nursing tasks – which are largely stress-inducing and put nurses in routine exposure to grief and suffering of others – (6, 18-22), data show that work environment factors in healthcare institutions are associated with nurses’ physical and emotional health (9, 21-27). Several aspects of the work environment in hospitals have been suggested to influence nurses’ health, including workload demands, nurse manager ability, leadership and support of nurses, staffing and resource adequacy, and workplace teamwork climate (28-30).

The majority of published studies focus solely on one health outcome or one aspect of the working environment. (9, 22) and data that systematically investigate multiple work environment factors and different nurses’ health outcomes are needed. Furthermore, to the best of our knowledge, there are no data on how allocation of nursing tasks to nurses versus other caregivers – an important component of daily nurses’ realities – relate to nurses’ physical and emotional health; in addition, the integration of detailed work environment assessments, namely using the domains of NASA Task Load Index (NASA-TLX) scale (31) is lacking.

In this study, we examined the relationship of various work environment factors with several physical and mental health conditions (musculoskeletal, cardiovascular, skin, mental health disorders and mental exhaustion) among Lebanese nurses. We characterized work environment factors, according to the RICH model (32) (33), into structural factors (including leadership, staffing resources, and teamwork climate)
and process of care factors (perceived workload and allocation of nursing tasks per professional category), while accounting for important organizational variables (shift and service). This study aimed (1) to describe the prevalence of physical and mental health outcomes and how these outcomes correlate with each other and (2) to assess how different work environment factors relate to specific nurses’ health outcome and to overall morbidity.

2 Methods

2.1 Study design

This sub-study is based on the cross-sectional phase of the RATIONAL study, “a longitudinal study on implicit rationing of nursing care among Lebanese patients” (33).

The RATIONAL study included two phases of data collection: 1) a cross-sectional baseline phase followed by 2) a longitudinal phase (33). The current paper analyses data collected in phase 1 of the parent study.

2.2 Setting and data collection

In 2018, 289 registered nurses (RNs) working in two of the largest academic hospital centers in Lebanon were surveyed in the cross-sectional study phase. The recruited RNs worked on 19 medical, surgical, and pediatrics acute care units. The two participating hospitals comprise 680 beds in total and allow both shift models: the 8-hour (day, evening, and night) and the 12-hour shift (day and night). For further details regarding the parent study, please refer to the protocol paper (33).

Data collection was carried out separately in the two participating hospitals. For Center A, the paper questionnaire version was used to collect RN's responses in June 2018. For Center B, the Lime survey electronic version of the questionnaire was used to collect the RN's responses in December 2018. Differences in data collection time and approach (paper vs online survey) was due to differences in hospital administration policy.

The Institutional Review Board of the American University of Beirut granted permission to conduct this research project on June 1st, 2018 (SBS.2017-0418). Participating hospital provided written consent and willingness to participate. Filling the surveys by RNs was considered as an informed consent.

2.3 Sources of data

The cross-sectional study included data from two sources:

1) Hospital administration data which included socio-demographic characteristics of the 289 recruited RNs (gender; age groups: 20-25 yrs, 26-30yrs, 31-35 yrs, 36-40 yrs, 41-45 yrs, 46-50 yrs, >50 yrs; and years
of nursing-experience: <2 yrs, 2-5 yrs, 6-10 yrs, 11-15 yrs, 16-20 yrs, >20 yrs), collected in an aggregated form as recommended by the American University of Beirut Institutional Review Board for anonymity; and 2) Nurse Personnel Questionnaire which included in-depth self-assessments of self-reported nurses’ physical and emotional health, nurses’ work environment, rationing of care per professional category and the type of working shifts and services. These nurses’ level data were used for the present study.

2.4 Variables and measurements

2.4.1. Outcome variables: Nurses’ physical and emotional health

*Nurses’ physical and mental health* was measured using four items of the “Work Ability Index (WAI)” (34), given their importance for nurses’ health: 1) musculoskeletal diseases (low back pain, neck and shoulder pain); 2) cardiovascular diseases (heart diseases and hypertension); 3) skin diseases (rash, eczema, allergy); and 4) mental disorders (depression, anxiety, chronic insomnia). The four types of diseases were surveyed using three answer options: “disease diagnosed by a doctor”, “own diagnosis of the disease”, and “disease does not exist”. We merged the “diagnosis by a doctor” and “own diagnosis” as both refer to “the presence of a disease” for each of the outcomes of interest; this resulted in a binary variable for each of the four types of diseases (0= disease does not exist; 1= disease is present). In sensitivity analyses of the work environment factors with each of the health outcomes, we verified that the presence of “own diagnosis” and “diagnosis by a doctor” categories showed overall similar associations, compared to the reference of no disease in multinomial logistic regression models; which supported our binary classification.

*Nurses’ work-related emotional exhaustion* was assessed using the “Maslach Burnout Inventory (MBI)” (35), a nine-item scale that capture nurses’ feeling about: (1) exhaustion from work, (2) exhaustion at the end of the working day, (3) tiresome when they get up in the morning to go to work, (4) tiresome from working all the day with human beings, (5) burned-out from their work, (6) frustration from their job, (7) too much effort required by their job, (8) stress from working directly with people, and (9) feeling at the end of their rope (35). The nine items are measured on a 7-point Likert-scale with increasing frequencies; the sum scores range between 0 and 54 with higher scores indicating more frequent emotional exhaustion. The sum scores were used to classify nurses into those experiencing low (scores< 27) and high (scores≥27) emotional exhaustion; the cut-off was based on a histogram of the sum scores which showed a bimodal distribution separated at the 27 sum scores, and this value coincided with other reports (36).

2.4.2. Work environment factors

*Self-perceived workload*
Self-perceived workload was assessed using the six items of the “NASA Task Load Index (NASA-TLX)” scale (31) which measure how much mental, physical, temporal, frustration, effort, and performance demands are required to carry tasks at workplace. Each of the items was measured on a scale of 0 (low demand) to 10 (high demand); the overall workload score is the average of the six items and higher scores indicate higher workload demands (31, 37, 38).

Leadership and staffing resources adequacy

Self-perceived nurse manager ability, leadership, and support of nurses as well as self-perceived staffing and resource adequacy were each assessed using two four-items subscales from the “Practice Environment Scale of the Nursing Work Index (PES-NWI)” questionnaire (30). The items of the two subscales were measured using a 4-point Likert scale ranging from one (strongly disagree) to four (strongly agree). To combine the four items within each subscale into one score of “leadership” and one score of “staffing resource adequacy”, we calculated the unweighted average of the four items within each subscale (39, 40), with higher scores indicating better leadership and staffing resource adequacy.

Teamwork climate

Nurses’ self-perceived teamwork climate was assessed using the teamwork climate subscale from the Safety Attitudes Questionnaire (SAQ) with a Cronbach alpha of 0.89 (41). The subscale includes five items measuring the presence of a teamwork and cooperative culture in the workplace. The items were rated on a 5-point Likert scale (1=strongly disagree, 2=slightly disagree, 3=neutral, 4=slightly agree, 5=strongly agree) and an average score was computed (42).

Allocation of nursing care per professional category

Participating RNs completed the “Basel extent of rationing of nursing care (BERNCA)” instrument, which assesses the nurse’s inability to carry out the 25 nursing tasks divided into 5 dimensions: 1) support daily living activities (six items), 2) documentation (three items), 3) rehabilitation, instruction, and education (four items), 4) monitoring and safety (two items), and 5) caring and support (ten items) (32). RNs were asked to select whether each of the BERNCA 25 items was done exclusively by RNs=1, mostly by RNs=2, mostly by other caregivers=3, or only by other caregivers=4. Each of the 25 items was classified into a binary variable (exclusively and mostly done by RNs=1 versus mostly and only done by other caregivers=0), the 25 binary items were then summed to compute an overall count for each nurse ranging from 0 (all tasks done either mostly or only by other caregivers) to 25 (all tasks done either exclusively or mostly by RNs).

Other work-related measures

The type of shift, service, and hospital center were captured as categorical variables: type of shift (1=day shift, 2=night shift); type of service (1=medical, 2=surgical, 3=pediatrics); and hospital center (1=Center A, 2=Center B). Evening shifts were recoded as day shifts due to the small count of evening shift responses.
2.5 Data analysis

The sample’s characteristics were measured using means and standard deviations for continuous variables and frequencies and percentages for categorical variables. We then describe the nurses’ health outcomes, work environment factors, and allocation of nursing care per professional category across different types of services and shifts and assessed whether they were different across these services and shifts using t-tests, chi-square tests, and one-way ANOVAs followed by Bonferroni post-hoc comparisons. We examined the relationship between the physical and emotional health outcome variables using Chi-square tests and Cramer’s V coefficients to compute their correlations. We also described the co-occurrence of health problems by counting for each RN, the number of health problems reported (ranging from 0 to 5). We estimated the association of each of the work environment factors and allocation of nursing care per professional category separately with each of the nurses’ physical and mental health outcomes, using multivariable binary logistic regression models adjusting for the type of working shift, service, and hospital center in each model. In additional analyses, we estimated the relationship of each work environment factor with the number of co-occurring diseases. In sensitivity analyses, we repeated these analyses including the explanatory variables of interest in the same model (mutually adjusting for all work environment factors and allocation of nursing care per professional category) and results were largely unchanged. All data analysis was conducted using STATA 14 and statistical significance was considered at p-value <0.05.

3 Results

3.1 Socio-demographic characteristics

Table 1 describes socio-demographic characteristics of the 289 RNs. Women constituted 73% of the sample; 44% of RNs were between the age of 20–25 years and 2% were older than 50 years. In terms of nursing experience, 43% of RNs had 2 to 5 years of experience and 5% had more than 20 years of experience. Overall, 189 RNs out of the 289 recruited RNs completed the study questionnaires and 170 provided complete responses for the survey questions resulting in a response rate with complete data of 59%.
Table 1
Socio-demographic descriptive data of the 289 registered nurses recruited

|                        | n (%)     |
|------------------------|-----------|
| Gender (Female)        | 210 (73%) |
| Age                    |           |
| 20–25 years            | 127 (44%) |
| 26–30 years            | 83 (29%)  |
| 31–35 years            | 49 (17%)  |
| 36–40 years            | 12 (4%)   |
| 41–45 years            | 8 (3%)    |
| 46–50 years            | 5 (2%)    |
| > 50 years             | 5 (2%)    |
| Nursing Experience     |           |
| < 2 years              | 62 (21%)  |
| 2–5 years              | 124 (43%) |
| 6–10 years             | 76 (26%)  |
| 11–15 years            | 11 (4%)   |
| 16–20 years            | 2 (1%)    |
| > 20 years             | 14 (5%)   |

3.2 Description of the study sample and variables

Among the 170 RNs, 67% worked day shifts; 55% worked in the medical units, 25% worked in the surgical units, and 20% worked in the pediatrics units (Table 2). In general, self-perceived workload scale had a mean score of 6.8 out of 10 (SD = 1.3). More specifically, the mean scores for the workload items were as follows: 8.6 (SD = 1.6) for mental demand, 7.6 (SD = 2.2) for physical demand, 7.6 (SD = 2.0) for temporal demand, 6.5 (SD = 2.4) for frustration demand, 7.7 (SD = 2.0) for effort demand, and 7.4 (SD = 2.2) for performance satisfaction (Table 2). The mean scores for the leadership and teamwork scales were 3 (SD = 0.6) out of 4 and 3.8 (SD = 0.7) out of 5, respectively. Staffing resources adequacy had a mean of 2.4 (SD = 0.8) out of 4.0 (Table 2). The average count of tasks done by RN computed from the BERNCA score was 16.5 (SD = 3.59) indicating that most necessary nursing tasks were on average done by RNs rather than other caregivers.
Table 2  
Description of the work environment and health outcomes among participating registered nurses (n = 170)

|                          | n (%)       | Mean (SD) |
|--------------------------|-------------|-----------|
| Working shift (Day)      | 114 (67%)   |           |
| Type of service          |             |           |
| Medical                  | 94 (55%)    |           |
| Surgical                 | 42 (25%)    |           |
| Pediatrics               | 34 (20%)    |           |
| Hospital (Center B)      | 90 (53%)    |           |
| Work environment factors (scale range) |           |           |
| Overall workload scale (0–10) | 6.8 (1.3)  |           |
| Workload items (0–10)    |             |           |
| Mental demand            | 8.6 (1.6)   |           |
| Physical demand          | 7.6 (2.2)   |           |
| Temporal demand          | 7.6 (2.0)   |           |
| Frustration demand       | 6.5 (2.4)   |           |
| Effort demand            | 7.7 (2.0)   |           |
| Performance satisfaction | 7.4 (2.2)   |           |
| Staffing resources adequacy (1–4) | 2.4 (0.8)  |           |
| Leadership (1–4)         | 3.0 (0.6)   |           |
| Teamwork climate (1–5)   | 3.8 (0.7)   |           |
| Safety climate (1–5)     | 3.9 (0.8)   |           |
| Count of tasks performed by RNs (scale range: 0–25) | 16.5 (3.6) |           |
| Health outcomes          |             |           |
| Musculoskeletal disease  | 117 (69%)   |           |
| Cardiovascular disease   | 63 (37%)    |           |
| Skin disease             | 71 (42%)    |           |
|                          | n (%)     | Mean (SD) |
|--------------------------|-----------|-----------|
| hMental disorder         | 95 (56%)  |           |
| iEmotional exhaustion    | 100 (59%) |           |
| dWorkload: the overall workload scale is the mean score of the six items of the NASA TLX scale (mental, physical, temporal, frustration, effort and performance satisfaction demands) where each item ranges from 0 to 10; higher scores indicate higher workload demands. eStaffing resources adequacy and leadership: a mean score of staffing resources adequacy subscale (4 items) and leadership subscale (4 items) ranging from 1 (strongly disagree) to 4 (strongly agree). |
| fTeamwork and patient safety climates: a mean score of teamwork subscale (5 items) and patient safety subscale (7 items) ranging from 1 (strongly disagree) to 3 (neutral) to 5 (strongly agree). |
| gCount of tasks performed by RNs: a score summarizing the number of tasks done exclusively and mostly by RNs. |
| hPhysical health diseases: 0 = disease does not exist, 1 = disease exists (based on own diagnosis or a diagnosis by doctor). iEmotional exhaustion: 0 = low emotional exhaustion, 1 = high emotional exhaustion. |

With regards to nurses’ health outcomes, 69% of RNs reported having musculoskeletal diseases, 37% reported having cardiovascular disease, and 42% reported having a skin disease. The prevalence of mental health problems and high emotional exhaustion were 56% and 59%, respectively (Table 2).

### 3.3 Work environment factors and nurses’ health outcomes across types of shift and service

Leadership and teamwork climate as well as five out of the six workload items (mental, physical, temporal, frustration, and effort demands) were not different between the day and night shifts nor between the medical, surgical, and pediatrics services (Table 3). Observed differences concerned the performance satisfaction measure of the NASA TLX workload scale which was lower in the medical (score mean = 7.0, SD = 2.3) versus pediatrics services (score mean = 8.3, SD = 1.9); nurses’ self-perceived staffing and resources adequacy which was lower in the surgical (subscale score mean = 2.2, SD = 0.9) compared to pediatrics services (subscale score mean = 2.7, SD = 0.8) (Table 3). Allocation of tasks to RNs did not show variability by shift but was higher in the pediatrics services (mean count of tasks performed by RNs = 18.1, SD = 3.9) as compared to the medical (mean = 16.3, SD = 3.3) and surgical (mean = 15.8, SD = 3.7) services (Table 3).
**Table 3**
Description of the work environment and health outcomes among participating registered nurses (n = 170)

| Type of shift | Type of service | Mean (SD) |
|---------------|-----------------|-----------|
|               | Day             | Night     | Medical | Surgical | Pediatrics |
| Work environment factors (scale range) | | | | | |
| aOverall workload scale (0–10) | 6.9 (1.3) | 6.5 (1.2) | 6.8 (1.3) | 7.0 (1.1) | 6.4 (1.3) |
| aWorkload items (0–10) | | | | | |
| Mental demand | 8.6 (1.4) | 8.4 (1.9) | 8.4 (1.6) | 8.9 (1.5) | 8.6 (1.7) |
| Physical demand | 7.7 (2.2) | 7.3 (2.1) | 7.5 (2.2) | 7.9 (2.2) | 7.6 (2.1) |
| Temporal demand | 7.9 (1.8)* | 7.2 (2.2)* | 7.6 (2.0) | 8.1 (1.8) | 7.2 (2.1) |
| Frustration demand | 6.7 (2.4) | 6.1 (2.4) | 6.6 (2.3) | 6.6 (2.7) | 5.9 (2.3) |
| Effort demand | 7.7 (1.9) | 7.7 (2.1) | 7.6 (2.0) | 8.0 (1.7) | 7.5 (2.3) |
| Performance satisfaction | 7.2 (2.3) | 7.8 (2.0) | 7.0 (2.3)** | 7.6 (1.9) | 8.3 (1.9)** |
| bStaffing resources adequacy (1–4) | 2.4 (0.8) | 2.4 (0.9) | 2.3 (0.8) | 2.2 (0.9)* | 2.7 (0.8)* |
| bLeadership (1–4) | 3.0 (0.6) | 3.0 (0.7) | 3.1 (0.6) | 2.9 (0.7) | 3.0 (0.6) |
| cTeamwork climate (1–5) | 3.8 (0.7) | 3.8 (0.7) | 3.8 (0.7) | 3.7 (0.7) | 4.0 (0.6) |
| cSafety climate (1–5) | 3.9 (0.8) | 3.8 (0.8) | 3.8 (0.8) | 3.8 (0.8) | 3.9 (0.7) |
| dCount of tasks performed by RNs (scale range: 0–25) | 16.6 (0.3) | 16.3 (0.5) | 16.3 (3.3)* | 15.8 (3.7)* | 18.1 (3.9)* |
| n (%) | n (%) | n (%) | n (%) | n (%) | n (%) |

Health outcomes
| Type of shift          | Type of service |
|-----------------------|-----------------|
| **Musculoskeletal disease** | 84 (74%) | 33 (59%) | 67 (71%) | 30 (71%) | 20 (59%) |
| **Cardiovascular disease** | 46 (40%) | 17 (30%) | 37 (39%) | 12 (29%) | 14 (41%) |
| **Mental disorder**     | 69 (61%) | 26 (46%) | 59 (63%) | 19 (45%) | 17 (50%) |
| **Skin disease**        | 51 (45%) | 20 (36%) | 43 (46%) | 15 (36%) | 13 (38%) |
| **Emotional exhaustion**| 70 (61%) | 30 (54%) | 57 (61%)* | 29 (69%)* | 14 (41%)* |

**P-value < 0.01; *P-value < 0.05**

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**a** Workload: the overall workload scale is the mean score of the six items of the NASA TLX scale (mental, physical, temporal, frustration, effort and performance satisfaction demands) where each item ranges from 0 to 10; higher scores indicate higher workload demands.

**b** Staffing resources adequacy and leadership: a mean score of staffing resources adequacy subscale (4 items) and leadership subscale (4 items) ranging from 1 (strongly disagree) to 4 (strongly agree).

**c** Teamwork and patient safety climates: a mean score of teamwork subscale (5 items) and patient safety subscale (7 items) ranging from 1 (strongly disagree) to 3 (neutral) to 5 (strongly agree).

**d** Count of tasks performed by RNs: a score summarizing the number of tasks done exclusively and mostly by RNs.

**e** Physical health diseases: 0 = disease does not exist, 1 = disease exists (based on own diagnosis or a diagnosis by doctor). **f** Emotional exhaustion: 0 = low emotional exhaustion, 1 = high emotional exhaustion.
Table 4
Correlation and co-occurrence of the nurses’ health outcomes (n = 170)

4A. Correlation between the nurses’ self-reported physical and mental health outcomes

|                        | Musculoskeletal disease | Cardiovascular disease | Mental disorder | Skin disease | Emotional exhaustion |
|------------------------|-------------------------|------------------------|----------------|-------------|---------------------|
| aMusculoskeletal       | 1                       |                        |                |             |                     |
| aCardiovascular        | 0.25**                  | 1                      |                |             |                     |
| aMental disorder       | 0.45**                  | 0.46**                 | 1              |             |                     |
| aSkin disease          | 0.26**                  | 0.41**                 | 0.37**         | 1           |                     |
| bEmotional exhaustion  | 0.19*                   | -0.002                 | 0.22**         | 0.006       | 1                   |

4B. Co-occurrence of nurses’ health outcomes

| Number of co-occurring health outcomes | n (%)   |
|---------------------------------------|---------|
| 0 (No reported disease)               | 17 (10.00%) |
| 1                                     | 34 (20.00%) |
| 2                                     | 25 (14.71%) |
| 3                                     | 34 (20.00%) |
| 4                                     | 40 (23.53%) |
| 5 (all five health outcomes)          | 20 (11.76%) |

**P-value < 0.01; *P-value < 0.05

Physical health diseases: 0 = disease does not exist, 1 = disease exists (based on own diagnosis or a diagnosis by doctor).

bEmotional exhaustion: 0 = low emotional exhaustion, 1 = high emotional exhaustion.

With respect to health outcomes, only emotional exhaustion was significantly different across the services, with 69% of RNs in the surgical service reporting high emotional exhaustion as compared to 41% in the pediatrics service (Table 3).

3.4 Correlation and co-occurrence of nurses’ health outcomes

The presence of mental health problems showed consistent correlations with all reported physical diseases (Cramer’s V ranging from 0.37 with skin disease to 0.45 and 0.46 for musculoskeletal and
cardiovascular disease; Table 4A). Other notable correlations included the correlation of cardiovascular and skin disease (Cramer's V = 0.41) and more moderate correlations between musculoskeletal disease and cardiovascular and skin disease (Cramer's V ~ 0.25; Table 4A). Only 10% of participating nurses reported no health problems; 70% had more than 2 co-occurring health conditions and over 35% of the sample had 4 or more co-occurring health problems (Table 4B).

### 3.5 Association of work-related factors with nurses’ reported physical and mental health outcomes

A total higher workload demand was associated with higher odds of musculoskeletal disease (OR 1.36, CI 1.03–1.80), mental disorder (OR 1.53, CI 1.16–2.01), and emotional exhaustion (OR 1.88, CI 1.38–2.55) among participating RNs (Table 5). More specifically, physical demands were related to higher odds of musculoskeletal disease (OR = 1.20 (95%CI = 1.03, 1.40)), higher temporal demands were associated with higher odds of musculoskeletal and mental health disorders (OR = 1.30 (95%CI = 1.09, 1.55); OR = 1.24 (95%CI = 1.05, 1.47)) and with higher odds of emotional exhaustion (OR = 1.26 (95%CI = 1.06, 1.47)), higher frustration and lower performance satisfaction were related to higher odds of mental disorders and emotional exhaustion, and higher effort demands were related to higher odds of emotional exhaustion (OR = 1.26 (95%CI = 1.06, 1.49)) (Table 5).
Table 5
Work environment factors and nurses’ health outcomes (n = 170)

| Work environment factors | Musculoskeletal disease | Cardiovascular disease | Skin disease | Mental disorder | Emotional exhaustion |
|--------------------------|-------------------------|------------------------|--------------|----------------|---------------------|
|                          | OR [95% CI]             |                        |              |                |                     |
| **(scale range)**        |                         |                        |              |                |                     |
| **Overall workload scale (0–10)** | 1.36 [1.03, 1.80]* | 1.18 [0.90, 1.53] | 1.11 [0.86, 1.43] | 1.53 [1.16, 2.01]** | 1.88 [1.38, 2.55]** |
| **Workload items (0–10)** |                         |                        |              |                |                     |
| Mental demand            | 1.08 [0.87, 1.34]       | 1.12 [0.90, 1.39]      | 0.95 [0.77, 1.16] | 1.07 [0.87, 1.31] | 1.15 [0.94, 1.42]   |
| Physical demand          | 1.20 [1.03, 1.40]*      | 1.08 [0.93, 1.25]      | 1.04 [0.90, 1.21] | 1.13 [0.98, 1.31] | 1.11 [0.96, 1.29]   |
| Temporal demand          | 1.30 [1.09, 1.55]**     | 1.03 [0.87, 1.21]      | 1.09 [0.93, 1.29] | 1.24 [1.05, 1.47]**| 1.26 [1.06, 1.49]** |
| Frustration demand       | 1.13 [0.98, 1.30]       | 1.09 [0.95, 1.25]      | 1.12 [0.98, 1.29] | 1.22 [1.06, 1.41]**| 1.39 [1.19, 1.62]** |
| Effort demand            | 1.03 [0.87, 1.22]       | 1.06 [0.91, 1.25]      | 0.98 [0.84, 1.15] | 1.07 [0.91, 1.25] | 1.26 [1.06, 1.49]** |
| Performance satisfaction | 1.01 [0.86, 1.18]       | 0.99 [0.85, 1.14]      | 1.00 [0.87, 1.16] | 0.82 [0.70, 0.97]* | 0.81 [0.69, 0.96]*  |
| b Staffing resources adequacy (1–4) | 0.82 [0.54, 1.25] | 1.26 [0.84, 1.90] | 1.15 [0.78, 1.72] | 0.81 [0.54, 1.20] | 0.54 [0.35, 0.82]** |
| b Leadership (1–4)        | 0.75 [0.43, 1.31]       | 0.71 [0.42, 1.21]      | 0.93 [0.56, 1.56] | 0.65 [0.38, 1.11] | 0.80 [0.47, 1.35]   |
| c Teamwork climate (1–5)  | 0.60 [0.36, 0.98]*      | 0.81 [0.51, 1.29]      | 0.71 [0.45, 1.12] | 0.62 [0.39, 0.99]* | 0.70 [0.44, 1.11]   |

* p < 0.05
** p < 0.01
† p < 0.001
|                         | Musculoskeletal disease | Cardiovascular disease | Skin disease | Mental disorder | Emotional exhaustion |
|-------------------------|-------------------------|------------------------|--------------|----------------|---------------------|
| **OR [95% CI]**         |                         |                        |              |                |                     |
| d Count of tasks        | 1.11 [1.01, 1.23]*      | 1.01 [0.92, 1.11]      | 1.11 [1.004, 1.23]* | 1.07          | 0.94 [0.85, 1.03]   |
| performed by RNs (0–24) |                         |                        |              |                |                     |

**P-value < 0.01, *P-value < 0.05, ϵ P-value < the false discovery rate corrected significance threshold**

Odds ratios estimated from regression models ran separately for each health outcome and each individual work-related predictor, adjusted for the hospital center (1 = Center A, 2 = Center B), type of shift (1 = Day shift, 2 = Night shift), and type of service (1 = Medical service, 2 = Surgical service, 3 = Pediatric service).

**Workload:** the overall workload scale is the mean score of the six items of the NASA TLX scale (mental, physical, temporal, frustration, effort and performance satisfaction demands) where each item ranges from 0 to 10; higher scores indicate higher workload demands.

**Staffing resources adequacy and leadership:** a mean score of staffing resources adequacy subscale (4 items) and leadership subscale (4 items) ranging from 1(strongly disagree) to 4(strongly agree).

**Teamwork and patient safety climates:** a mean score of teamwork subscale (5 items) and patient safety subscale (7 items) ranging from 1(strongly disagree) to 3(neutral) to 5(strongly agree).

**Count of tasks performed by RNs:** a score summarizing the number of tasks done exclusively and mostly by RNs.

Better teamwork climate was associated with lower odds for both musculoskeletal (OR = 0.60, 95% CI 0.36–0.98) and mental health problems (OR = 0.62, 95% CI 0.39–0.99). Higher staffing and resources adequacy was associated with a 54% lower odds for emotional exhaustion (95% CI 0.35–0.82). A higher count of tasks done by RNs being associated with musculoskeletal and skin disease with each additional task performed by RN related to 1.11 higher odds of musculoskeletal (95% CI = 1.01, 1.23) and skin diseases (95% CI = 1.004, 1.23; Table 5).

In additional analyses exploring the number of co-morbidities, we found that higher overall workload and physical, temporal and frustration demands and lower teamwork climate were associated with a higher number of co-morbidities (Supplemental Table S1).

### 4 Discussion

The data from two Lebanese hospitals show that nurses carry a large health burden with the most prevalent health problems being musculoskeletal and mental conditions and emotional exhaustion. It is also these outcomes that were most consistently linked to several work environment factors. Higher total workload demands and higher temporal demands as well as poorer teamwork climate were related to higher odds of all three of musculoskeletal and mental health problems and emotional exhaustion. All other aspects of workload (except for mental demands) were related to either musculoskeletal disorder or...
mental health problems and emotional exhaustion. More adequate staffing resources was related to lower emotional exhaustion and higher allocation of care to RNs was associated with higher odds of musculoskeletal and skin diseases.

The prevalence of health problems among Lebanese nurses tend to be in the higher ranges as compared to reports from other countries on the prevalence of work-related musculoskeletal disease and mental health problems among nurses. For instance, the 69% prevalence for musculoskeletal diseases observed in our sample is closer to the upper range of the reported 40% and 85% prevalence in other countries (11–15). A recent study conducted by Yang et al. (2019) in China showed that 97% of the studied nurses suffered from at least one work-related musculoskeletal problem with 80.91% reporting low back pain, 78.6% reporting neck pain, and 70.4% reporting shoulder pain (9). With regards to mental health problems, other reports from around the world have estimated a 45.3% prevalence (3) and the prevalence of emotional exhaustion was found to be 26% in Brazil (43), 30% in the USA (19), 43% in Spain (21), and 50% in Turkey (20). Over half of the RNs in our sample reported the presence of mental disorders and/or high emotional exhaustion, highlighting a higher prevalence of these important problems among Lebanese nurses. In addition to their elevated prevalence, mental health conditions were strongly correlated with each of the physical diseases outcomes in our sample. This suggests an important burden for these diseases not only on emotional wellbeing but also on co-morbidities and other functional aspects of nurses’ health. Indeed, our data also show a high prevalence of co-occurrence of health problems among nurses and that only a minority (10%) do not have any health problem at all.

With the exception of temporal demands which are higher in the day shift, we found no variability between the type of working shifts regarding nurses’ self-perceived workload demands, work environment factors, allocation of nursing care per professional category (39), and nurses’ health outcomes. In contrast, recent research have found higher rates of physical and psychological risks among nurses working in the night shifts in comparison to the day shifts (6, 44). Reported staffing resources and adequacy, performance satisfaction, and allocation of tasks to RNs were higher in pediatric services and emotional exhaustion was lowest in this services. All other work environment factors and health outcomes were not different across pediatric, surgical, and medical services. Overall, the shifts and services comparisons show large overlap and similarities in work-related factors, NASA TLX workload demands, and health outcomes across both shifts and services, suggesting that nurses’ subjective perspectives and experiences regarding the workplace environment and their role in the care delivery process can be more informative than more objective occupational demands encountered in specific service and shift conditions (45). These results as well as the associations with health outcomes discussed below highlight the importance of integrating measures such as the NASA TLX workload domains to capture nurses’ perceived workload.

Several work-related factors (workload demands, staffing adequacy, team climate, and allocation of nursing care) were related to two health components, musculoskeletal disease and mental health/emotional exhaustion problems. These results suggest potentially more direct and shorter-term relationship between workplace factors and nurses’ musculoskeletal and mental health rather than the
potentially longer-term effect on cardiovascular diseases. This notion is further supported by the workload demands’ analysis with observed associations between physical demands and musculoskeletal disease specifically whereas workload aspects related to frustration, effort, and performance satisfaction were related to mental health/emotional exhaustion problems. Higher temporal demands and poorer team climate were related to the presence of both musculoskeletal and mental health/emotional exhaustion problems. These findings suggest a close tracking between the perceived problems in workload demands and health outcomes. This could be explained by the cross-sectional collection of data, wherein a nurses’ perception of their health and work problems could be correlated. Results could also suggest more direct links between different stresses in the environment and their manifestation in a related health problem among nurses.

Previous studies looking at specific work environment factors showed that higher workload demand and the absence of teamwork climate were significantly associated with the presence of musculoskeletal diseases among RNs (9, 26). A cross-sectional study in Spain showed a negative relationship between emotional exhaustion and each of staffing and resources adequacy and nurse manager ability, leadership, and support of nurses (21). Furthermore, teamwork climate manifested in good working relationships and communication between nurses was significantly associated with low emotional exhaustion among nurses working in Brazilian (46) and Italian hospitals (22). Our findings complement these results and further suggest that several aspects of the working environment are related to musculoskeletal and mental/emotional health among nurses with more direct relationships between certain physical-related demands and musculoskeletal disease whereas associations with mental health problems and mental health exhaustion is diffuse and widespread across 7 of the 10 investigated work-related factors.

In addition, a novel finding is the inverse relationship between lower allocation of nursing tasks to other caregivers and higher odds of musculoskeletal and skin disease. Allocation of care per professional category was not related to the mental health outcomes, suggesting that this component of the work may have a more direct impact related to physical demands and problems (e.g., more daily tasks, more usage of gloves, higher exposure to strain and skin infections) and may not contribute substantially to the general work-related stress influencing mental health indicators. This finding motivates further research and efforts to optimize allocation of nursing tasks in a manner that can simultaneously protect patients’ care and safeguard nurses’ health.

Longitudinal studies are needed to confirm the temporality of these findings and to further explore the presence of a longer-term influence of nursing work environment and risk of cardiovascular disease. Research has shown that jobs involving rotating shift work such as nursing jobs alters the normal human biologic clock, interferes with normal sleeping patterns and affect the normal nutrition diet of workers; thus resulting in increased risk for cardiovascular diseases at older ages (47, 48). Future studies will benefit from assessing more detailed aspects of nurses’ health, including identifying the most prevalent specific types of health problems within each health category (e.g., shoulder pain, depression, etc.) as well as risk factors for chronic diseases (e.g., hypertension, diet, earlier markers of emotional distress).
Such data can help in better identifying mechanisms by which certain work factors influence health and in improving the timely diagnosis, course and management of health burden on nurses.

5 Limitations

The current study might have included response bias which is a common phenomenon in healthcare research where self-reported data is used (49). The surveys were all filled without identifying information, yet potential biased rating of self-assessed behavior resulting from social desirability cannot be ruled out. In addition, the survey was cross-sectional so having a disease could be related to more negative views on the working environment. A third limitation is that the current study did not adjust for the socio-demographic characteristics of the RNs in the multivariate binary logistic regression models due to institutional restrictions, which provided the socio-demographics in an aggregated manner to avoid identifying individual RNs. The study involved multiple hypothesis testing and spurious associations could have been observed. However, there are some consistencies in the direction of associations and their magnitude. After correction for multiple testing using false discovery rate under dependence assumptions guided by the methods of Benjamini and Yekutieli (50), associations of total workload scores, temporal demand, frustration, and staffing with mental health and emotional exhaustion and that of temporal demand with musculoskeletal disease remained significant; and conclusions were still in line with the wider pattern of associations of work-related factors and mental health/emotional exhaustion problems. Lastly, our results focused on two large private hospitals in an urban setting; more data are needed to characterize the experiences of nurses in other public and more rural settings in Lebanon and the region.

6 Conclusions And Nursing Management Implications

Our study suggests an elevated prevalence of health problems among registered Lebanese nurses, with the most prevalent being musculoskeletal and mental/emotional health conditions and that nurses’ mental/emotional health conditions were highly correlated with the presence of other illnesses. Importantly, our results show that several work-related factors are associated with these health conditions. Overall workload, temporal demands and team climate were related to both these health aspects. In addition, results show a more direct association between musculoskeletal and skin problems and factors related to physical burden, namely higher physical and less allocation of nursing tasks to other caregivers, whereas mental health problems were related to various components of workload demands. From a local public health perspective, results highlight high health risk among Lebanese nurses, particularly mental and emotional health risks and suggest the value of a more comprehensive approach towards improving the work environment, including improving resources and workloads and team climate. Prioritizing and addressing working environment challenges can help in maximizing the health and experiences of both patients and nurses.

7 List Of Abbreviations

RN
registered nurse  
MBI  
Maslach Burnout Inventory scale  
NASA-TLX  
NASA Task Load Index scale  
PES-NWI  
Practice Environment Scale of the Nursing Work Index questionnaire  
SAQ  
Safety Attitudes Questionnaire  
BERNCA  
Basel extent of rationing of nursing care  

Declarations

Ethical approval and consent for participation and publication:

The Institutional Review Board of the American University of Beirut granted permission to conduct this research project on June 1st, 2018 (SBS.2017-0418). Participating hospital informed us in writing its willingness to participate. Filling the surveys by registered nurses was considered as an informed consent for participation and publication.

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Conflict of Interest:

Authors declare no conflict of interest

Data availability statement:

The datasets generated and analyzed for the current study are not publicly available due to IRB agreements but are available from the corresponding author on reasonable request.

Authors contributions:
| Criteria                                                                 | Authors initials |
|-------------------------------------------------------------------------|-----------------|
| Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data | ME; MA; SD; MS; DA |
| Involved in drafting the manuscript or revising it critically for important intellectual content | ME; MA; SD; MS; DA; ND; HA |
| Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content; | ME; MA; SD; MS; DA; ND; HA |
| Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. | ME; MA; SD; MS; DA; ND; HA |

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