



# Back pain occurrence and treatment-seeking behavior among nurses: the role of work-related emotional burden

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## Abstract

**Purpose** To assess the association of back pain and treatment-seeking behavior for such pain with work-related emotional burden (regret about care), regret coping strategies, and physical burden among newly practicing nurses.

**Methods** We used data from the Impact of Care-related Regret Upon Sleep (ICARUS) cohort collected between 05.2017 and 07.2018 using web-based surveys (weekly for measures of emotional burden, physical burden and coping strategies, and monthly for back pain and seeking care). We investigated immediate associations and temporal influences between burdens and back pain with linear mixed models and cross-lagged Bayesian models, respectively. Coefficients were standardized to allow comparison between burdens. Logistic regression was used to examine the association of burdens with seeking care.

**Results** Among 105 nurses with an average follow-up of 3 months, 80 reported at least one episode of back pain. Neither physical nor emotional burdens had an immediate association with back pain. However, number of days with back pain in a given month was associated with an increase in both burdens during the previous month, with similar degrees of association (emotional:  $b = 0.24$ , physical:  $b = 0.21$ ). Decision to seek treatment was associated with an increase in back pain frequency (OR 1.12,  $p = 0.04$ ) and intensity (OR 1.80,  $p = 0.002$ ) and a decrease in emotional burden (OR 0.95,  $p = 0.03$ ). Coping strategies were associated neither with the occurrence of back pain nor with care-seeking.

**Conclusion** While both emotional and physical burdens were associated with increased frequency of back pain the following month, emotional burden additionally showed a negative association with the decision to seek care.

**Keywords** Back pain · Emotional burden · Physical burden · Regret · Seeking healthcare

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## Introduction

Back pain is a major health issue of the working population [1], ranked among the top single causes of work absenteeism in the Western world [2]. Nurses have one of the highest levels of back problems among all occupational groups [3], and being a nurse was found to be an independent risk factor for spinal pain [4]. In addition to its significant personal and societal costs [5], back pain has an impact on nurses' work efficiency [6], job satisfaction [7], and absenteeism [7, 8]. Moreover, occupational back pain among nurses was associated with poor quality of life [9–11] and it was found that scores measuring quality of life correlated with pain and disability scores of back pain [12–14]. Because of its high prevalence and negative impacts on health and productivity, a better understanding of the factors influencing the occurrence of back pain among nurses is warranted.

Initially, mechanical factors were seen as the most influential factors for the development of back pain among nurses [15, 16]. However, the widely accepted biopsychosocial model [17] now recognizes back pain as being more than a simple anatomical or physiological derangement of the spine mechanics. In addition to physical loading, poor ergonomics, and reduced back muscle endurance, psychosocial factors profoundly influence back pain among healthcare workers. These include prior psychological conditions [18, 19], night shift work [20], perceived lack of encouraging culture [21], work conflicts [22], and perceived lack of support at work [7, 21, 23]. These factors affect the workers' perception of pain [24] as well as their care-seeking behavior [24–26].

In addition to factors related to their work environment, nurses face many emotional challenges that are associated with providing nursing care [27]. These arise from the need to respond to life-threatening situations and to make critical decisions about the best possible care for patients in a context with prevailing pressure and uncertainty. Such challenges can elicit various emotional states including moral distress [28], perception of inappropriate care provision [29, 30], loss of control during the process of patient care [31], as well as regret following errors [32, 33].

Regret is an emotion experienced when one believes that the current situation would have had a better outcome if one had behaved differently [34]. It is a normal and frequently experienced emotion [35] that plays a key role in decision-making [36]. Although regret can be beneficial in promoting positive change in clinical practice [37], previous studies have shown that it has a negative effect on self-rated health and sick leave [38], job satisfaction and turnover intention [39, 40], insomnia severity [41], and on sleep patterns among healthcare professionals

[42]. However, to the best of our knowledge, no study has yet investigated whether regret can also influence physical health outcomes, such as back pain, or the decision of nurses to seek medical care for treating this problem. Additionally, comparisons of the relative impact of physical and emotional burdens are scarce and not focused on nurses.

Therefore, the aim of the present study was to assess the association of work-related regret (one of the emotional components of the biopsychosocial model), intense physical activity at work (the physical component), and coping strategies with back pain among a cohort of professional nurses. Additionally, we assessed whether regret and coping strategies were associated with the decision of nurses to seek medical care for back pain, as such decision is critical to ensure effective secondary prevention.

## Methods

### Study design and participants

Data for this study were derived from the Impact of CARE-related Regret Upon Sleep (ICARUS) cohort study [43]. ICARUS is an international study that aims to collect longitudinal data on the association between care-related regret and various health and psychological outcomes. The studied sample included newly practicing nurses recruited in the last year of their study and working in acute care hospitals and clinics selected from a random sample of French, English, German, or Danish-speaking countries (e.g., Australia, Austria, Botswana, Canada, Denmark, France, Haiti, Ireland, Kenya, United Kingdom, and United States of America). The ICARUS cohort study consists of a web-based survey with weekly assessments during the first year, followed by 6-month assessments in the second and third years. The data collection started in May 2017 and is still ongoing. For the current analysis, the data were extracted from the ICARUS database in July 2018. To be included in the analyzed sample, participants had to be nurses, speak French, English, German, or Danish, and complete the web survey that included questions on back pain. Back pain was assessed each month. We excluded respondents who had not provided care to patients in the last 6 months. As an incentive, a small donation to a charity (Theodora Foundation) of 0.5 Swiss franc (CHF) for each completed survey was made. This study was approved by all relevant local Ethics Committees, and all participants signed informed consent forms. See [42] for more details on the ICARUS protocol.

**Measures**

**Outcomes**

*Back pain* was the main outcome variable. Participants were asked to report how many days per month they experienced back pain (0–31), the intensity of their back pain on a scale from 1 to 10, and the number of days during the previous month where the pain exceeded 2 on a scale from 1 to 10. These questions were formulated according to the standardized definition of back pain episodes [44, 45]. They are commonly used to assess the occurrence, frequency, intensity, and duration of back pain.

*Decision to seek medical care* was obtained by asking participants whether they sought medical care (consultation, medication, physiotherapy, or other) for their back pain. Only the 80 nurses who had at least 1 day of back pain were asked to answer this item.

Both outcomes were assessed monthly.

**Explanatory variables**

*Number of recent regrets* was assessed by using a single item: “During the last week, how many patient-care situations have there been in which you experienced regret?”, with an open (numerical) answer.

*Regret intensity* was assessed by using the following single item [42]: “What would you say is the average level of intensity of your feelings of regret about the situations that happened last week?”, with 10 ordinal response options ranging from 0 (null) to 10 (very high). If participants reported no regret over the last 7 days, a mean intensity of 0 was inputted.

*Coping strategies* were assessed by using the Care-related Regret Coping Scale for Healthcare Professionals (RCS-HCP) [46]. The RCS-HCP evaluates the use of

different coping strategies nurses may employ to deal with care-related regret. The scale contains 15 items divided into 3 subscales: problem-focused strategies, emotion-focused adaptive strategies, and emotion-focused maladaptive strategies. Respondents answered to each item on a four-point Likert scale ranging from 1 (never or almost never) to 4 (always or almost always).

*Intense physical burden* was assessed in the part of the survey focused on work activities by using a single item: “During the last week, how many days did you do vigorous physical activity for at least 10 min,” with a scale ranging from “no day” to “7 days.”

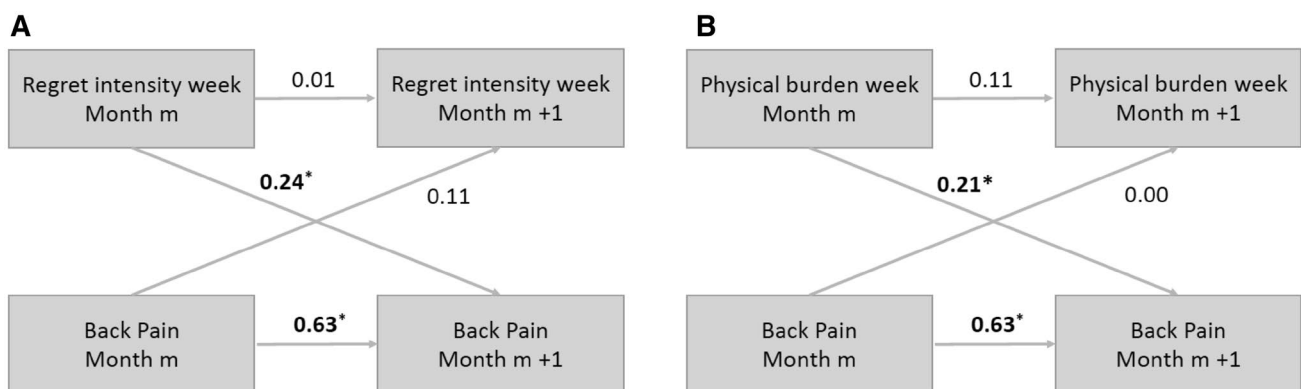
**Covariates**

The following variables were included as covariates in the models: for the nurses, age, gender, number of night shifts, and sick leaves. For the regretted patient-care situation, number of perceived consequences for the patient (supplementary supervision, resuscitation measures, prolonged hospitalization, and physical or psychological permanent impairment) and perceived medical errors (yes/no).

All explanatory variables and covariates were assessed weekly. Yet, in this study, we only used data assessed at the same time point as that of the back pain measurement.

**Statistical analyses**

We performed univariable and multivariable linear mixed models to assess the association of emotional and physical burdens with back pain at the same time point, adjusting for covariates. Visual inspection of residual plots showed that the assumptions were respected, and analyses with Poisson linear mixed models found similar results. We further tested the circular influence between regret and back pain in a series of cross-lagged Bayesian models. In these models,



**Fig. 1** Cross-lagged associations (standardized coefficients) between **a** regret intensity and number of days with back pain and **b** between physical burden and number of days with back pain. \*The credible

interval does not include 0. The Bayesian cross-lagged models do not allow adjustment for covariates

we estimated the cross-lagged association of regret at a given time with back pain of the following month, simultaneously with the cross-lagged association of back pain in a given month with regret 1 month later (Fig. 1). To examine the main direction of the influence, we compared the strength of the cross-lagged associations using the standardized within-person coefficients. All analyses were performed with R using lme4, lmerTest, coda, R2OpenBUGS packages, and penBUGS [47]. Finally, we used logistic mixed-effect models to examine the associations of regret with decision to seek medical care for back pain. Nagelkerke pseudoR<sup>2</sup> was estimated to determine the percentage of variance explained. To compare the associations of back pain with emotional and physical burden, these models were also tested using intense physical burdens instead of regret. We also examined whether coping strategies explained the associations between regret and the two outcomes (i.e., back pain and decision to seek medical care) in two ways. First, we ran the same analyses, adjusting for coping strategies. Second, we examined interaction effects of coping style with emotional and physical burdens.

## Results

### Descriptive results

A total of 105 nurses (346 observations) followed for 4 months on average, were included. Of these, 58 nurses had at least 1 day of back pain on their first measurement after enrollment. During the whole follow-up period, 80 nurses had at least 1 day of back pain. Those 80 nurses were included in the sample for the decision to seek medical care analysis. On the first measurement, the average number of days with back pain during the previous month was  $4.30 \pm 6.42$  and the average number of regrets in 1 week was  $0.62 \pm 0.97$ . Among the 58 nurses (55%) who had at least on 1 day of back pain on the first measurement, the average number of days with back pain in 1 month was  $7.7 \pm 6.8$ . Among the 40 nurses (38%) who experienced at least one regret on the first measurement, the average regret intensity was  $4.57 \pm 2.29$ . Furthermore, throughout the study duration, 34 nurses out of 80 who had at least one day of back pain (43%) had taken the decision to seek medical care because of back pain (Table 1).

### Association of regret and regret coping strategies with back pain at the same time point (cross-sectional) (Table 2)

Number of days with back pain was not associated with regret (number of regrets and regret intensity), regret coping strategies, intense physical burden, and the other covariates

**Table 1** Participants' characteristics on the first occasion of measurement ( $N = 105$ )

	Mean <sup>c</sup>	SD <sup>c</sup>
Outcome		
Number of days with back pain	4.30	6.42
Decision to seek medical care <sup>a</sup> (yes; %)	34	43.3
Emotional burden		
Regret intensity <sup>d</sup>	4.57	2.29
Number of regrets	0.62	0.97
Coping strategies use (from 1 rarely to 4 almost always)		
Problem-focused strategies	2.37	0.64
Emotion-focused adaptive strategies	2.43	0.63
Emotion-focused maladaptive strategies	1.98	0.73
Physical burden <sup>b</sup>	0.78	1.19
Covariates		
Age	29.7	11.2
Gender (women; %)	101	96.2
Number of night shifts	0.65	1.30
Perceived consequences for the patient <sup>d</sup>	0.32	0.66
Perceived medical error <sup>d</sup> (Yes; %)	20.0	50%
Number of sick leave	0.09	0.46

<sup>a</sup>For decision to seek medical care, the variable was available for participants who reported back pain ( $n = 80$ )

<sup>b</sup>For physical burden, the variable was available only for a subset of participant ( $n = 95$ )

<sup>c</sup>When not specified otherwise

<sup>d</sup>For these variables, the descriptive statistics were calculated on the sample of nurses who experienced at least one regret at the first occasion of measurement ( $n = 40$ )

at the same time point, either in the univariable or in the multivariable models (although some marginal associations emerged in the multivariable model).

### Association of regret and physical burden with back pain at a 1-month interval (cross-lagged Bayesian models; Table 3)

#### Regret

Regret intensity was variable over time and intensity at one time point was not associated with intensity at the next time point. In contrast, the number of days with back pain in a given month was associated with the number of days with back pain in the following month ( $b_{\text{back pain} \rightarrow \text{back pain}} = 0.62$ , 95% credible interval: [0.36, 0.87]). Cross-lagged associations of regret on back pain were significant, whereas back pain on regret was not. Specifically, regret intensity in a given week was significantly associated with an increased number of days with back pain in the following month ( $b_{\text{regret intensity} \rightarrow \text{back pain}} = 0.24$ , 95% credible interval: [0.02,

**Table 2** Linear mixed models for number of days with back pain and test of mediation with coping strategies

Outcome: number of days with back pain	Univariable models		Multivariable models	
	<i>b</i>	<i>p</i> value	<i>b</i>	<i>p</i> value
<b>Fixed effects</b>				
<b>Emotional burden</b>				
Regret intensity	0.11	0.300	0.35	0.074
Number of regrets	-0.18	0.618	-0.94	0.083
<b>Coping strategies</b>				
Problem-focused	0.54	0.358	0.64	0.350
Emotion-focused adaptive	-0.41	0.470	-0.62	0.358
Emotion-focused maladaptive	-0.66	0.225	-1.09	0.063
Physical burden <sup>a</sup>	-0.09	0.736		
<b>Covariates</b>				
Duration of follow-up (month)	0.03	0.268	0.02	0.375
Gender (ref: male)	1.32	0.175	2.66	0.465
Number of night shifts	0.16	0.455	0.15	0.497
Perceived consequences for the patient	0.97	0.272	0.65	0.516
Perceived medical error	0.08	0.911	-0.09	0.923
Number of sick leave	-0.89	0.268	-0.85	0.289

<sup>a</sup>For physical burden, the variable was available only for a subset of participant (*n*=95)

0.47]). A 4-point change in regret intensity (range 0–10) was associated with about one more day with back pain in the following month. Conversely, number of days with back pain in a given month was not associated with regret intensity one month later. No association was observed between number of regrets and number of days with back pain.

**Physical burden**

Intense physical activities were also variable over time and the burdens at one time point were not associated with the burden at the next time point. Cross-lagged associations of intense physical burden on back pain were significant, whereas back pain on physical burden was not. Specifically, intense physical burden in a given week was significantly associated with an increased number of days with back pain in the following month ( $b_{\text{intense physical burdens} \rightarrow \text{back pain}} = 0.21$ , 95% credible interval: [0.07, 0.35]). A 5-point change in

intense physical burden (range 0–7) in a given week was associated with about one more day with back pain in the following month. Conversely, number of days with back pain in a given month was not associated with intense physical burden one month later.

**Magnitude of emotional and physical burdens**

The magnitude of the association between regret intensity and the number of days with back pain in the following month was quite similar to the association between intense physical burden and the number of days with back pain in the following month ( $\beta_{\text{regret intensity} \rightarrow \text{back pain}} 0.24$  vs.  $\beta_{\text{intense physical burdens} \rightarrow \text{back pain}} = 0.21$ ).

**Associations of regret and regret coping strategies with the decision to seek medical care for back pain (Table 4)**

**Univariate models**

Decision to seek medical care for back pain was positively associated with the number of days with back pain (Odds Ratio (OR) 1.12, *p* = 0.022, Nagelkerke pseudoR<sup>2</sup> = 0.11) and with average back pain intensity (OR 1.80, *p* = 0.002, Nagelkerke pseudoR<sup>2</sup> = 0.21). Moreover, number of regrets was associated with a decreased chance of seeking medical care (OR 0.82, *p* = 0.022, Nagelkerke pseudoR<sup>2</sup> = 0.25). By contrast, intensity of regret was not associated with the decision to seek medical care. To better reflect the overall regret experience, we built a variable multiplying the number of regrets with the intensity of regret (e.g., 3 regrets with an average intensity of 6 would yield a score of 18). This overall regret experience was also linked to a decrease in the odds of seeking medical care (OR 0.95, *p* = 0.026). Coping strategies, intense physical burden, and the covariates were not significantly associated with the decision to seek medical care for back pain.

**Multivariable models**

The models were adjusted for the frequency (i.e., number of days of back pain) and intensity of back pain as these variables could be meaningful confounders of the association

**Table 3** Raw and standardized coefficients for the cross-lagged models examining the associations of the number of days with back pain with emotional and physical burdens

	Burdens to back pain		Back pain to burdens	
	Raw (95% credible interval)	Std	Raw (95% credible interval)	Std
Regret intensity	0.53 (0.00;1.08)	0.24	0.11 (-0.04;0.26)	0.27
Number of regrets	1.09 (-0.10;2.25)	0.21	0.00 (-0.04;0.04)	0.00
Intense physical activities	0.70(0.04;1.35)	0.21	0.00 (-0.09;0.09)	0.04

*Std* within-person standardized coefficient

**Table 4** Association of regrets and regret coping strategies with the decision to undertake a therapeutic approach for the back pain

Outcome: decision to seek medical care for back pain	Univariable model	
	OR (95% CI)	<i>p</i> value
Fixed effects		
Back pain experiences		
Number of days with back pain	1.12 (1.05; 1.22)	0.022
Number of days with back pain with intensity > 2	1.12 (1.01; 1.24)	0.040
Average back pain intensity	1.80 (1.25; 2.59)	0.002
Weekly regret experiences		
Regret intensity	0.83 (0.64; 1.06)	0.131
Number of regrets	0.82 (0.68; 0.97)	0.022
Overall regret experience	0.95 (0.91; 0.99)	0.026
Physical burden <sup>a</sup>	1.27 (0.79; 1.98)	0.344
Weekly regret coping strategies		
Problem-focused	0.84 (0.42; 1.71)	0.635
Emotion-focused adaptive	1.25 (0.57; 2.85)	0.548
Emotion-focused maladaptive	0.95 (0.47; 1.91)	0.888
Covariates		
Gender (ref: male)	1.34 (0.08; 22.1)	0.841
Number of night shifts	1.05(0.92; 1.21)	0.471
Perceived consequences for the patient	0.66 (0.16; 2.80)	0.580
Perceived medical error	0.31(0.08; 1.14)	0.079
Number of sick leave	2.94 (0.50; 17.28)	0.235

<sup>a</sup>For physical burden, the variable was available only for a subset of participant ( $n=67$ ). Overall regret experience was computed as number of regrets multiplied by the average regret intensity

between burden and back pain. The decision to seek medical care for back pain remained negatively associated with the number of regrets (OR 0.81,  $p=0.025$ ) and remained unrelated with intensity of regret. The association between the overall regretted experiences and the decision to seek medical care for back pain remained significant (OR 0.95,  $p=0.033$ ). The overall regretted experience explained more variance of the decision to seek medical care (Nagelkerke pseudo $R^2=0.34$ ) than number of regrets alone (Nagelkerke pseudo $R^2=0.32$ ) or regret intensity alone (Nagelkerke pseudo $R^2=0.26$ ). The physical burden explained less variance in the decision to seek medical care than the emotional burden (Nagelkerke pseudo $R^2=0.25$ ).

## Discussion

The present study aimed to examine the relative contribution of care-related emotional burden and physical burden to (1) occurrence of back pain among nurses and (2) decision of nurses to seek medical care for back pain. Results showed no immediate cross-sectional association of emotional and physical burdens to back pain. However, when the relationship was examined over time, it revealed a unidirectional temporal relationship between emotional burden and back pain in the following month—higher regret intensity was associated with an increased number of days with back pain

in the following month. The examination of a relationship between negative emotional processes and pain has begun decades ago [48] and has since evolved to give rise to the now widely accepted biopsychosocial model [49]. It is now known that negative emotional states affect physical health in various ways [50]. Consistent with previous research on psychological distress [51], fear avoidance [52], depression [53], and stress [54], this research shows for the first time that a relationship exists between regret, a normal and common emotion, and the occurrence of back pain.

These findings add empirical evidence that work-related psychological risk factors contribute to occupational back pain. Several studies have examined effects of social support at work [55], hostile work environment [56], job control [23], and job security [57] on occurrence of back pain in occupational populations. However, to the best of our knowledge, this is the first study to explore the association between care-related regret and back pain. Because regret is a non-pathological, and frequently encountered emotional experience among nurses, these findings shed light on the process underlying the occurrence of back pain among this occupational cohort. The observation that regret could influence physical health was also consistent with previous studies showing that emotional experiences can have adverse effects across domains of psychological and physical functioning [58]. Moreover, the current findings are in line with previous studies showing that care-related regret were associated

with sleep problems [42], insomnia severity [41], higher sick leave and poorer self-rated health [38], as well as lower job satisfaction and higher turnover intention [39, 40].

Unlike our current results, these previous studies found that coping strategies partly explained the association between regret exposure and these outcomes. Our findings, however, are supported by a recent systematic review revealing that most studies show no direct associations between emotional regulation strategies and pain [59]. Rather, coping strategies are viewed as secondary risk factors, which do not affect pain intensity, but influence the overall well-being, functioning, and quality of life of individuals with pain. Still, emotional regulation seems to be a good target for pain prevention and management programs [60].

The study also examined the effect of physical burden on back pain, and an association was found between intense physical activities at work and back pain in the following month. These associations were quite similar in terms of magnitude to those found for regret intensity and back pain, thereby suggesting that emotional burden is linked to the occurrence of back pain to the same extent as physical burden. These findings, although preliminary, may have important implications for the design of programs to reduce back pain among nurses. Benefits of occupational back pain interventions designed to reduce physical demands have been found to be small and of limited cost-effectiveness [61, 62]. In addition, the psychosocial components are often overlooked in these programs [23]. Management of chronic back pain in non-occupational settings has progressed towards multidisciplinary biopsychosocial approaches [63, 64], which seem to provide more benefit to patients than physically based interventions [65]. Addressing emotional issues in work-related interventions is still in its infancy [66], but it has the potential to improve the effectiveness of these interventions in reducing the burden of back pain among nurses.

The decision to seek medical care for back pain was increased for nurses with higher number of days with back pain and higher back pain intensity, in line with studies showing that back pain intensity influences the decision to seek medical care [67]. We found a negative association between regret experiences and decision to seek medical care: the more healthcare professionals experienced regret, the less they sought medical care. In contrast, we found no association with physical burden, coping strategies or other covariates. Very little work has focused on care-seeking behavior for back pain. One retrospective case–control study found that psychosocial factors were less important predictors of care-seeking than physical loads [25]. The discrepancy in results could be explained by the design of the studies. In our prospective study, nurses report their burden before seeking care, whereas in the case–control study, the participants were asked to report their emotional and physical burdens after deciding to seek care, potentially resulting

in a recall bias. Such an explanation for the discrepancy may actually support our findings. Participants may feel vindicated for seeking care when it is for a psychological reason, explaining the results from the retrospective study. In our study, back pain caused by emotional burden may have led to less care-seeking if participants feel that it is less justified to seek care for emotional, compared to physical, burden. Another explanation for the discrepancy may come from the manner in which emotional and physical burdens were assessed. For instance, we focused on care-related regret, but previous studies focused on excessive work, conflicting demands, authority over decision-making, and social support at work. The negative influence of regret could partially explain why, despite the fact that nurses are among the occupational groups with the highest back pain occurrence, consultation for back pain was lower than in other occupations requiring the same level of education [25].

In our study, we found that regret intensity in a given week, but not number of regrets, was associated with an increased number of days with back pain in the following month. On the other hand, the decision to seek medical care was negatively associated with number of regrets but not regret intensity. A possible interpretation of this difference in the type of regrets associated with back pain and decision to seek care may relate to differences in burdens associated with “regret intensity” versus those associated with “number of regrets.” Intensity of regret corresponds more to a sudden and strong event, potentially overcoming psychological regulation strategies, and leading to a psychosomatic consequence. It could be compared to a strong physical effort leading to a pulled muscle. In contrast, number of regrets is more akin to constant strain, or accumulation of daily minor regrets [68] potentially leading to longer-term psychological damage, which may remain silent for a long time. As such, feelings of worthlessness (maladaptive strategies) or even burnout might explain why nurses were reluctant to seek help.

This study has several strengths. It is the first study to examine the relationship between care-related regret and occurrence of back pain, as well as care-seeking for it. The study was conducted as a multicenter, international, prospective study where directional relationship between variables could be assessed. We also adjusted for several important confounders, including night shifts, medical errors, and sick leaves. The study also has several limitations. First, back pain was defined by number of days with back pain and pain intensity but not with the number or length of back pain episodes, which may be more important than the number of individual days. In addition, the outcome measure was not formally validated; however, as noted in the methods section, it was based on a standardized definition. Second, the physical burden was assessed using a single item that was not specifically designed to assess the physical demands of

jobs in healthcare. This lack of specification may have led to different interpretations by the participants; thus, it might have attenuated some potential associations between physical burden and treatment-seeking behavior. This may have led to an underestimation of the true associations between the two variables; therefore, the nonsignificant associations observed should be regarded with caution. Although the results are consistent with our hypothesis, further studies focusing on healthcare work-related physical tasks are necessary to confirm this observation. Third, the sample size was moderate, even if this was compensated by using repeated measurements over time. Fourth, attrition is a common issue in longitudinal studies and may lead to a selection bias in the remaining sample. Nurses who initially enrolled were included in the analysis, and only 10 participants asked to leave the study. Data collection is still ongoing; therefore, a final attrition rate cannot be accurately determined, making it unfortunately difficult to comment on the representativeness of our sample. Fifth, on average, the follow-up duration of this intermediate analysis was only 12 weeks. The duration is relatively short in comparison with the expected follow-up period at the end of the data collection. Sixth, the high proportion of women in our sample could mean that our findings may not generalize as well to men. Back pain is more common in women than men [69]. This may be due to hormonal differences, differences in pain perception, or risk factors for back pain specific to women such as pregnancy, though most of these hypotheses have not been supported by previous studies [70, 71]. Seventh, the study did not collect data on the work setting (clinical specialty, healthcare context) and consequently was not able to control for the workloads of different job-related tasks. These loads vary widely between nursing tasks and are significant risk factors for musculoskeletal injury [56, 72]. Finally, the ICARUS study did not collect data on social support, which may impact the appraisal of pain.

In conclusion, this study provides evidence of an association between care-related regret and the occurrence of back pain among nurses and suggests that both emotional and physical burdens are linked to back pain. In addition, regret was associated with a reduction in the decision to seek medical care for back pain. Since coping strategies were not associated with back pain and seeking care, these findings suggest that primary prevention of emotional burdens, in addition to the physical ones, is necessary. In addition, interventions for back pain among nurses should be designed to address overlooked elements of the biopsychosocial model, namely the emotional element, and encourage care-seeking for it.

**Author contributions** MEI, BC, and DSC designed the analyses and drafted the manuscript. MEI, BC, DSC, and DM analyzed the data.

All authors critically appraised and approved the final version of the manuscript.

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## Compliance with ethical standards

**Conflict of interest** The authors declare they have no conflict of interests.

**Ethical approval** The study was approved by the Ethics Committee of Geneva Canton, Switzerland (reference number: CCER2016-02041), the Ethics Committee of London South Bank University (reference number: HSCSEP/17/06), and the University Research Ethics Committee of Bedfordshire (reference number: UREC106). Other study centers deemed local ethical approval unnecessary since the main ethics committee (Geneva) had already accepted the project.

**Informed consent** An informed consent was obtained from all participants included in the study.

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