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Psychological resilience to trauma and longitudinal sleep outcomes among current and former nurses

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ABSTRACT

Objective: A life-disrupting stressor (e.g. pandemic) may cause or exacerbate poor sleep health; resilience may offset impacts. We assessed relationships between pre-pandemic psychological resilience to trauma and sleep-related outcomes during the first year of the pandemic among current and former nurses.
Methods: Using data from 18,670 women in the Nurses' Health Study II, we characterized pre-pandemic resilience by cross-classifying experiences of higher versus lower lifetime trauma burden with unfavorable, adequate, and favorable psychological health (through January 2020). Sleep was measured before (2017) and during the pandemic, including: changes, quality, and duration. We modeled trajectories of sleep duration assessed at five time points (pre-pandemic in 2017, and then in four COVID-19-related surveys, 2020–2021) using latent class growth analysis.
Results: We observed four trajectories of sleep duration, all showing stable patterns, with averages ranging from 5.5 to 6 to 8.5–9 h of sleep per 24 h. Women with higher trauma/unfavorable psychological health had the highest risk for all poor sleep outcomes (e.g., RR for being in the shortest sleep trajectory versus healthy sleep duration: 2.53; 95 % CI: 2.21, 2.91). Relative to women categorized as most resilient, only women with lower trauma/favorable psychological health showed lower risk of getting less sleep after the pandemic started compared to no change (RR: 0.76; 95 % CI: 0.70, 0.83). This same pattern was observed for poor sleep quality.
Conclusion: Higher pre-pandemic resilience may have protected women against poor sleep outcomes during the pandemic. Findings could have long-term health implications, particularly if they generalize to other stressors.

1. Introduction

Sleep quality and duration are closely intertwined with physical and mental health. Stress, female sex (particularly in older age groups) and psychological distress have all been identified as risk factors for poor sleep health [1,2]. The COVID-19 pandemic represents an intense collective stressor, during which time many individuals reported worse overall sleep [3] and increased psychological distress [4], particularly in

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the first year of the pandemic. Research also suggests that women were disproportionately affected by these negative psychological health effects, partially due to greater caregiving burdens [3]. An open question is whether psychological resilience can protect sleep health in the face of significant stressors. This study investigates relationships between pre-pandemic psychological resilience and sleep health among female nurses in the first year of the COVID-19 pandemic. Given the nature of the stressor, nurses are a particularly relevant study population as they were more likely to be on the front lines of the pandemic and experiencing some of the highest related burdens. Although the pandemic has ended, insights from this distinct time period may provide insight to inform prevention and response efforts during future collective stressors.

Poor sleep quality and unhealthy sleep duration (too little or too much sleep) are robustly associated with multiple serious physical health problems and premature mortality [5,6,7,8]. Poor sleep health is an established risk factor for the development of cardiovascular health problems [9,10,11]. Importantly, lack of quality sleep can impair immune system and cognitive functioning, which may increase susceptibility to a range of physical and mental health conditions [12]. As essential workers, health care professionals working on the front lines during the pandemic faced additional occupational and COVID-19-related stresses and may have been getting less sleep early in the pandemic as a result [12].

1.1. Resilience to trauma and its relation to sleep and long-term health

Prior exposure to trauma may put individuals at heightened risk for poor health outcomes in the face of subsequent stressors, as posited by the stress sensitization hypothesis [13]. Conversely, psychological *resilience to trauma* may protect against poor health outcomes following later stress. Resilience is a multidimensional construct, which has often been conceptualized as an individual capacity or trait, usually measured by individual self-assessment [14,15]. Prior research has shown higher trait resilience to be associated with getting the recommended number of hours of sleep per night (7–9) among older women [16] and with better long-term physical health outcomes [17,18,19]. However, over time resilience has increasingly been understood as involving several components that may not be captured by self-reported trait measures, and which may be inferred through observable outcomes such as by expressing favorable aspects of psychological well-being [20,21] and/or low levels of psychological distress [22,23], despite exposure to a potentially traumatic event. Much of the literature linking resilience to sleep outcomes has utilized trait measures of resilience [24,16,25], while few have examined resilience as a combination of prior trauma exposure, psychological distress, and well-being (i.e., considering both lived experience and psychological functioning). Thus, the current study utilizes this type of outcome-based resilience measure, building on recent work considering how resilience to trauma may influence downstream biobehavioral and health outcomes [26].

A systematic review of the link between resilience and chronic diseases suggested that higher psychological resilience is health promotive and is negatively associated with depression, anxiety, and progression of physical illness [17]. In research considering psychological resilience during the COVID-19 pandemic specifically, higher trait resilience was associated with greater physical activity and lower psychological distress among Australian adults [19], and lower resilience was associated with reduced sleep quality in a cross-sectional analysis of 64 adult women [25].

1.2. Present study

In the current study, our primary aim was to investigate the relationships between different levels of psychological resilience assessed prior to the pandemic and sleep quality and duration in the first year of the pandemic, using longitudinal data from the Nurses' Health Study II, a large, well-characterized cohort of female current and former healthcare professionals. By defining resilience as having higher levels of psychological health (including both favorable wellbeing and low levels of psychological distress) in the aftermath of trauma exposure, we extend the literature in this area to examine how adaptive responses to trauma may relate to sleep outcomes during a time of collective stress (i.e., the early COVID-19 pandemic). We hypothesized: 1) that lower pre-pandemic resilience would be associated with higher risk of adverse changes in sleep duration and worse sleep quality early in the pandemic; 2) that lower pre-pandemic resilience would be associated with trajectories of sleep duration characterized by shorter sleep over time throughout pandemic follow up; and 3) in an exploratory hypothesis, that these relationships between resilience and sleep outcomes might differ among nurses who were versus were not working on the front line (i.e., not working remotely or retired), due to the immense additional stress at work during the COVID-19 pandemic. Investigating these relationships may highlight protective effects of intervenable psychological assets on biobehavioral outcomes, revealing opportunities for fostering resilience to trauma as a health promotive intervention on both individual and population level scales.

2. Methods

2.1. Study sample

The Nurses' Health Study II (NHSII) began in 1989, enrolling 116,429 female registered nurses across the United States, aged 24 to 42 years at baseline. The participants have completed regular follow-up surveys every two years since, assessing sociodemographic, medical, and behavioral factors. In addition to these biennial questionnaires, smaller sub-studies have investigated more specific research questions on subsets of the larger cohort. As part of one sub-study focusing on trauma and post-traumatic stress disorder (PTSD) beginning in 2018, 51,486 women who completed the 2017 biennial questionnaire and had a known email address were invited to complete an online survey [27]. Between August 2018 and January 2020, 33,845 participants responded to this sub-study (65.7 % response rate). Beginning in May 2020, an additional online sub-study was initiated to investigate the effects of the COVID-19 pandemic, inviting 55,925 currently active cohort participants. By August 2020, 39,564 women had completed the COVID-19 baseline questionnaire (70.7 % response rate). These participants were then subsequently invited to complete follow-up questionnaires on a rolling basis, beginning one month after they finished the prior questionnaire and eventually moving to a schedule of every three months since they finished the prior survey, up to one year after completing the baseline COVID-19 questionnaire. Our sample for this study comprised women who competed the regular 2017 biennial questionnaire, the 2018–2020 PTSD sub-study, and at least the baseline survey of the COVID-19 sub-study ($n = 23{,}766$ overall). The sample was then further restricted to participants who had valid data on the psychological health variables used to measure psychological resilience ($n = 22{,}626$). Finally, we restricted the analyses to include only women who reported one or more traumatic events before the pandemic (on the 2018–2020 PTSD sub-study), because experiencing trauma (and thus being at risk for PTSD) is part of the definition of psychological resilience. In total, 18,670 women met these criteria (**Fig. S1**).

This study protocol was approved by the Institutional Review Boards of the Brigham and Women's Hospital and the Harvard T.H. Chan School of Public Health. Return of completed questionnaires implied consent.

2.2. Exposure: psychological resilience

We created a 6-level categorical measure of pre-pandemic resilience to prior trauma by cross-classifying higher versus lower lifetime trauma burden (assessed in 2018–2020) by unfavorable, adequate, and favorable psychological health (measured in 2017–2020). Psychological

health was defined as a composite of validated measures of both distress in various forms (depression, PTSD, generalized anxiety disorder (GAD)) and psychological well-being in various forms (optimism, purpose, life satisfaction), consistent with prior work [22,28]. See **Fig. S2** and **Table S1** for details on the timing and measurement of these variables, briefly described below.

To measure trauma burden (assessed on the 2018–2020 PTSD sub-study), we used a modified version of the Brief Trauma Questionnaire which included 16 different types of traumatic experiences [27,29]. Following prior work [30,31], we then split the number of types of traumas at the sample mean (after excluding those with no trauma), to estimate lower trauma burden (1–2 trauma types) vs. higher trauma burden (3 or more trauma types). In prior work within this cohort using the same resilience construct, findings were comparable in sensitivity analyses comparing different cut points of trauma burden [22]. Operationalizing trauma burden in this way is consistent with research highlighting the cumulative impacts of trauma exposure [32,33]. For psychological health, favorable was defined as not meeting validated cut-offs for any measure of distress and meeting the cut-off for at least one measure of positive well-being. Adequate psychological health was defined as scoring below validated cut-offs for any of our distress measures, but also scoring below cut-offs for all measures of positive well-being. Unfavorable psychological health was defined as meeting the validated cut-off for at least one measure of distress, regardless of positive well-being.

Measures of distress included *depression*, measured with the short form Center for Epidemiologic Studies Depression Scale (in 2018–2020) [34]; *PTSD*, measured with a modified version of the PTSD Checklist for DSM-5 (in 2018–2020) [35,27,36]; and *anxiety*, measured with the GAD-7 (in the biennial questionnaire beginning in 2017) [37]. The well-being aspect of psychological health included measures previously identified as characterizing subjective well-being and eudemonic well-being: *life satisfaction* (5-item Satisfaction with Life Scale [38], completed in 2018–2020), *optimism* (6-item Life Orientation Test-Revised [39], reported in 2018–2020), and *purpose* (3-item purpose in life subscale of the Psychological Well-being Scale [40], reported in 2017). Sample median splits were used for these three cut-offs. Additional information on definitions and cut-offs are in **Table S1**.

The overall categorical resilience variable was then defined by cross-classifying trauma burden (lower versus higher) by psychological health (unfavorable, adequate, and favorable psychological health). This yielded six groups representing a conceptual gradient of psychological resilience: those with higher trauma burden but favorable psychological health (representing the highest resilience to trauma); those with higher trauma burden but adequate psychological health, or those with lower trauma burden and favorable psychological health (both representing high resilience levels); those with lower trauma burden and adequate psychological health (representing moderate resilience levels); and finally, those showing unfavorable psychological health with either higher or lower trauma burden (representing the lowest resilience levels). See [22] for a graphical representation of this conceptualization of categorical resilience.

2.3. Outcomes: sleep measures

Perceived change in sleep duration since the start of the pandemic and perceived sleep quality at the start of the pandemic were both assessed on the COVID-19 baseline survey. Perceived sleep change was queried with the question, “Has the amount of sleep you get changed since the pandemic started?” and response options “decreased”, “no change”, or “increased”. For the regression, we modeled risk of reporting less sleep since the start of the pandemic (“decreased” sleep), compared to no change in sleep amount. Perceived sleep quality at the start of the pandemic was assessed on the same survey with the question, “In the past 7 days, how would you rate your sleep quality overall?” and response options “very good”, “fairly good”, “fairly bad”, or “very bad”. For the regression, we dichotomized these options into fairly bad or very bad, compared to very good or fairly good sleep quality.

Average sleep duration per 24-h period was first assessed pre-pandemic, on the 2017 NHSII biennial questionnaire, with response options of less than 4 h, 5, 6, 7, 8, 9, or 10 or more hours. Average sleep duration per 24-h period was then queried at four of the COVID-19 surveys: at baseline; beginning 56 days after baseline survey completion (heretofore referred to as “COVID-19 time 2”); beginning 168 days after baseline survey completion (“COVID-19 time 3”); and beginning 336 days after baseline survey completion (“COVID-19 time 4”, roughly one year after baseline). On the COVID-19 surveys, average sleep duration in the past 7 days had the same response options as in the 2017 survey, but with the addition of an “11 or more hours” category, which we combined with the 10 h category to match the “10 or more hours” response option in the 2017 survey.

To assess how well participants’ self-report of changes in sleep duration since the start of the pandemic (at the COVID-19 baseline survey) matched what they reported for the pre-pandemic duration in 2017 (i.e., their recall), we compared their responses to the perceived sleep change question to the estimated numerical difference between their reported 2017 sleep duration response and their COVID-19 baseline sleep duration response. We found responses were consistent overall, suggesting accurate reporting; more detail is available in the **Appendix**.

2.4. Covariates

We adjusted for a range of potential confounders including sociodemographic and health characteristics that could influence both psychological resilience and sleep patterns. Potential confounders included age (in years, at the time of the 2018–2020 PTSD sub-study), race (categorized into white and non-white given small numbers of individuals’ self-report being of non-white race, measured in 1989), education (Associate degree, Bachelor’s, Master’s, Doctorate, or missing/other; reported in the 2018–2020 sub-study), marital status (married, divorced/separated, widowed, single, other; reported in the 2018–2020 sub-study), living arrangement at the start of the pandemic (living with others, living alone, missing; reported on the baseline COVID-19 survey), quartile of census tract-level median family income (measured in 2013 based on the 2010 Census), history of common chronic health conditions (cancer, stroke, heart attack; reported on biennial questionnaires through 2017), sleep quality in 2017 (restless or very restless compared to average, sound, or very sound), and sleep duration in 2017 (categorized into 6 or fewer hours, 7–8 h, 9 or more hours). Sleep quality and duration in 2017 were used as covariates only for the outcomes of less sleep since the start of the pandemic and poor sleep quality at the start of the pandemic (i.e., not for the models predicting trajectory groups, given that 2017 was included as one of the trajectory data points comprising that outcome).

2.5. Effect modifier

Being a frontline healthcare worker at the beginning of the pandemic (yes/no) was measured on the baseline COVID-19 survey and defined as physically working or volunteering in a hospital, temporary COVID-19 facility, healthcare clinic outside a hospital, nursing home or group care facility, home health, school clinic, or other healthcare facility (not including remote work), since March 1, 2020.

2.6. Statistical analyses

First, we calculated age-adjusted means and frequencies of all covariates, overall and by levels of pre-pandemic psychological resilience. To estimate trajectories of sleep duration over time including the pre-pandemic measure, we applied latent class growth analysis using the Proc Traj procedure in SAS, a semi-parametric method that identifies

underlying data patterns for a variable across multiple time points using slopes and intercepts, to estimate latent trajectory groups [41,42]. In an iterative fashion, we tested different numbers of trajectory groups and different functional forms for the trajectory paths, using criteria including the Bayesian Information Criteria, Akaike Information Criterion, average posterior probabilities for membership into each group, and visual differentiation between the different groups together to choose the best-fitting model overall [42]. We identified a four-group model with sleep duration modeled with a normal distribution as the best-fitting model, with all predicted probabilities of group membership greater than 88 %.

To assess the relationships between resilience to trauma assessed prior to the pandemic and perceived changes in sleep duration and sleep quality at the COVID-19 baseline survey, we ran covariate-adjusted log binomial regression, which produced risk ratios for each level of resilience (with the higher trauma, favorable psychological health group as the reference) in relation to reporting 1) less sleep since the start of the pandemic and 2) poor sleep quality at the start of the pandemic.

To test the relationship between pre-pandemic psychological resilience to trauma and sleep duration trajectory membership (i.e., sleep duration over time), we ran a covariate-adjusted multinomial regression, with resilience as the exposure and the four trajectory groups described above as the outcomes, with the healthy sleep duration trajectory as the outcome reference group.

Finally, we assessed potential effect modification by frontline healthcare worker status at the start of the pandemic by running the three regressions described above, stratified by worker status.

3. Results

3.1. Sample description

The mean age of the sample was 64.7 years, and the majority were white (96.4 %) and married (73.9 %; Table 1). At the start of the

Table 1
Distribution of covariates, overall and by pre-pandemic psychological resilience groups, among 18,670 current or former nurses with trauma history in the Nurses' Health Study II.[a]

		Pre-Pandemic Psychological Resilience					
	Full Sample (n = 18,670)	Higher trauma, unfavorable psych health, n = 3109, 16.7 %	Lower trauma, unfavorable psych health, n = 1441, 7.7 %	Higher trauma, adequate psych health, n = 1449, 7.8 %	Lower trauma, adequate psych health, n = 1165, 6.2 %	Higher trauma, favorable psych health, n = 5849, 31.3 %	Lower trauma, favorable psych health, n = 5657, 30.3 %
	%(n)	*%(n)*	*%(n)*	*%(n)*	*%(n)*	*%(n)*	*%(n)*
Age, *mean (SD)*	64.7 (4.5)	64.4 (4.5)	64.2 (4.6)	65.1 (4.4)	64.6 (4.5)	64.9 (4.5)	64.7 (4.6)
White race	96.4 (18,002)	96.2 (2991)	97.4 (1404)	95.9 (1389)	97.3 (1133)	96.1 (5620)	96.6 (5465)
Marital status							
Married	73.9 (13,731)	64.2 (1985)	68.9 (989)	66.7 (959)	69.8 (808)	76.2 (4436)	80.9 (4554)
Separated/Divorced	12.8 (2381)	19.4 (598)	14.0 (201)	16.1 (232)	13.4 (155)	12.1 (703)	8.7 (492)
Widowed	6.5 (1201)	7.5 (232)	8.3 (119)	8.5 (122)	7.7 (89)	6.0 (351)	5.1 (288)
Single	5.0 (934)	6.3 (196)	7.6 (109)	6.8 (98)	8.2 (95)	3.7 (215)	3.9 (221)
Other marital status	1.7 (325)	2.6 (79)	1.2 (17)	1.8 (26)	0.9 (11)	2.0 (118)	1.3 (74)
Education							
Associate's degree	22.7 (4247)	24.9 (775)	24.1 (348)	26.4 (383)	25.0 (291)	20.9 (1221)	21.7 (1229)
Bachelor's degree	39.9 (7449)	39.5 (1229)	42.7 (616)	41.3 (598)	43.4 (506)	38.3 (2238)	40.0 (2262)
Master's degree	29.4 (5489)	28.3 (879)	26.8 (386)	25.3 (366)	25.9 (302)	31.5 (1842)	30.3 (1714)
Doctorate degree	5.1 (953)	5.2 (161)	2.8 (41)	3.8 (55)	2.5 (29)	6.6 (385)	5.0 (282)
Missing or other education	2.8 (532)	2.1 (65)	3.5 (50)	3.2 (47)	3.2 (37)	2.8 (163)	3.0 (170)
Median household income							
Quartile 1	25.0 (4658)	27.7 (861)	25.1 (361)	26.0 (376)	23.8 (277)	25.0 (1461)	23.4 (1322)
Quartile 2	24.9 (4642)	25.4 (790)	25.7 (370)	27.5 (398)	24.7 (287)	24.5 (1432)	24.2 (1365)
Quartile 3	25.1 (4687)	24.2 (751)	25.5 (366)	24.6 (356)	27.0 (314)	25.0 (1457)	25.6 (1443)
Quartile 4	25.0 (4652)	22.6 (703)	23.7 (341)	21.9 (317)	24.5 (285)	25.5 (1489)	26.9 (1517)
Living arrangement							
With Others	82.9 (15,480)	76.6 (2383)	78.6 (1132)	77.1 (1117)	81.1 (945)	85.3 (4987)	86.9 (4916)
Alone	15.2 (2845)	20.7 (644)	19.6 (282)	20.2 (292)	16.3 (190)	13.0 (762)	11.9 (675)
Missing living arrangement	1.8 (345)	2.6 (82)	1.9 (27)	2.8 (40)	2.6 (30)	1.7 (100)	1.2 (66)
Chronic physical health conditions [b]	19.8 (3690)	22.0 (683)	17.3 (249)	22.4 (325)	16.1 (187)	21.4 (1252)	17.6 (994)
Sleep duration in 2017							
6 or fewer hours	28.6 (5329)	38.2 (1187)	36.2 (520)	31.6 (458)	32.3 (375)	25.1 (1465)	23.4 (1324)
7–8 h	63.8 (11,891)	51.2 (1590)	54.9 (790)	60.5 (876)	62.2 (722)	67.9 (3964)	69.9 (3949)
9 or more hours	7.6 (1420)	10.6 (328)	8.9 (128)	7.9 (114)	5.5 (64)	7.0 (411)	6.6 (375)
Frontline healthcare worker at the beginning of pandemic	29.7 (5550)	29.0 (902)	30.5 (439)	29.7 (431)	33.1 (386)	29.5 (1725)	29.5 (1667)

[a] Percentages for categorical variables may not sum to 100 % due to rounding or missing values. Missingness not shown above: 0.5 % missing marital status, 0.2 % missing median census tract household income, and 0.2 % missing 2017 sleep duration. Missingness higher than these amounts are listed as separate rows above. Psych = psychological.

[b] Chronic conditions include history of cancer, stroke, or heart attack, reported on biennial questionnaires through 2017.

pandemic, 29.7 % were active healthcare workers and 82.9 % lived with others in their household. Overall, participants classified as being in the highest resilience group (having favorable psychological health despite higher trauma) comprised the largest proportion of the sample (31.3 %). The next most common group was having lower trauma and favorable psychological health, also considered a resilient group (30.3 %). Relative to other groups, women in these higher resilience groups were more likely to be married (e.g., 76.2 % were married in the higher trauma/favorable psychological health group compared to 64.2 % married in the higher trauma/unfavorable psychological health group), and less likely to have chronic physical health conditions (e.g., 17.6 % had chronic conditions in the lower trauma, favorable psychological health group compared to 22.0 % with chronic conditions in the higher trauma, unfavorable psychological health group).

3.2. Sleep descriptives

On the COVID-19 baseline survey, 17.9 % reported getting less sleep since the start of the pandemic, compared to either more sleep (19.3 %) or no change (63.0 %). Among women who reported less sleep since the start of the pandemic, 57.8 % also reported "fairly bad" or "very bad" sleep quality in the past seven days, compared to only 18.6 % reporting those responses in the overall sample.

Fig. 1 shows the results of the best-fitting trajectory model from the latent class growth analysis. We observed four different trajectories of average sleep duration across the five time points in 2017–2021, but all trajectories were similar in shape, showing that sleep duration was relatively stable across time. We considered the group consistently getting on average 7.5–8 h of sleep per 24-h period as the "healthy sleep" trajectory (31.9 % of the sample), based on recommendations from the National Heart, Lung and Blood Institute (NHLBI, 2022) [43]. The most common (or "average sleep") group was getting about 6.5–7 h of sleep per 24-h period (47.2 %). About 13.5 % of participants fell into the "short sleep" group of 5.5–6 h per 24-h period, and 7.4 % fell into the "long sleep" group, getting about 8.5–9 h per 24-h period.

3.3. Associations between psychological resilience and sleep outcomes

Pre-pandemic psychological resilience was associated with changes in sleep levels, in a dose-response relationship (Fig. 2). Compared to the reference group of higher trauma/favorable psychological health, after adjusting for covariates, women with higher trauma/unfavorable psychological health were the most likely to report less sleep since the start of the pandemic relative to no change (RR: 1.75; 95 % CI: 1.61, 1.89). Only women with lower trauma/favorable psychological health showed lower risk of less sleep than the higher trauma/favorable psychological health group (RR: 0.76; 95 % CI: 0.70, 0.83).

The relationship between psychological resilience and sleep quality at the start of the pandemic showed the same pattern (Fig. 3). Against the same reference group, the higher trauma/unfavorable psychological health group had the highest risk ratio for reporting fairly bad or very bad sleep quality compared to fairly good or very good sleep quality, after adjusting for confounders (RR: 1.64; 95 % CI: 1.51, 1.78). The lowest risk group was again the lower trauma/favorable psychological health group (RR: 0.80; 95 % CI: 0.73, 0.88).

Table 2 shows the results from a covariate-adjusted multinomial logistic regression model, where the outcomes were latent class membership in the four trajectory groups described above and in Fig. 1, with the healthy sleep duration trajectory as the outcome reference group. We again observed associations between the different resilience groups (the exposure) and these sleep outcomes. Overall, lower compared to higher resilience was associated with membership in both the short sleep duration group and long sleep duration group, compared to healthy sleep duration. For example, as compared to the higher trauma/favorable psychological health group (defined as most resilient), having lower trauma but unfavorable psychological health (i.e., one of the "lower resilience" groups) was associated with over twice the risk of being in the short sleep duration group (RR: 2.06; 95 % CI: 1.72, 2.45), and a 77 % higher risk of being in the long sleep duration group (RR: 1.77; 95 % CI: 1,42, 2.21) versus being in the healthy sleep duration group. Similarly, women with higher trauma/unfavorable psychological health had 2.53 times the risk of being in the shortest sleep duration trajectory compared to a healthy sleep duration trajectory: (95 % CI:

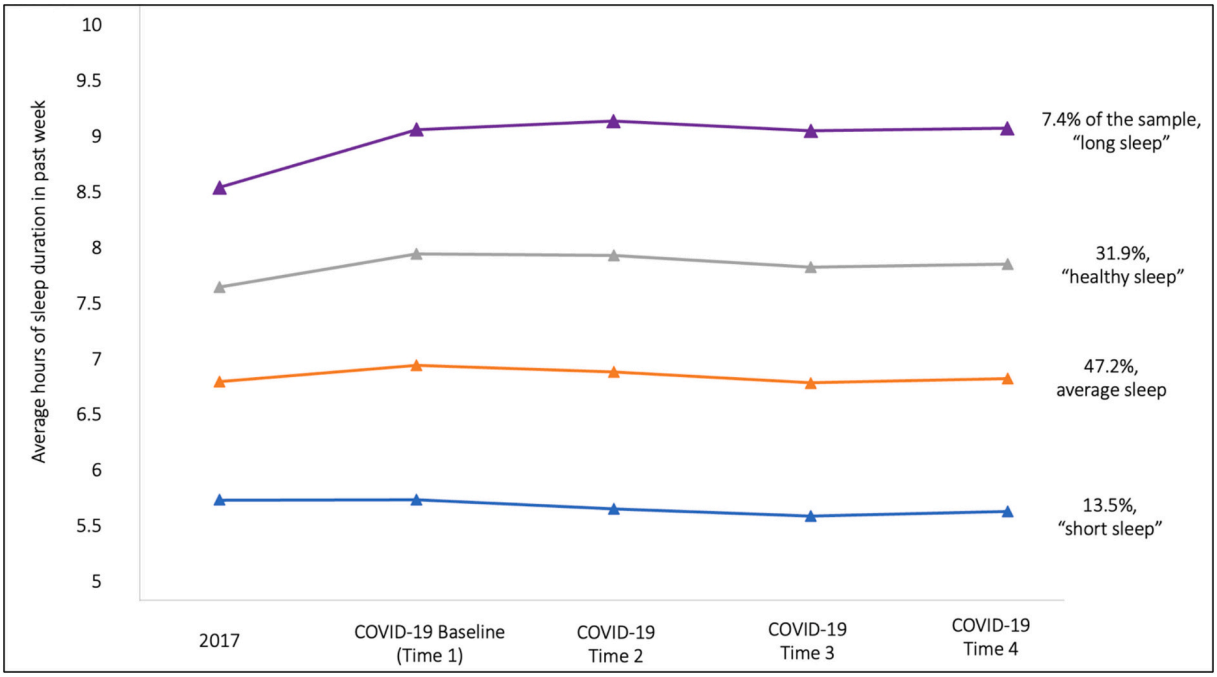

Fig. 1. Best fitting model for latent class growth trajectories of average sleep duration reported before and during the COVID-19 pandemic, among 18,670 women with trauma history in the Nurses' Health Study II.
For graphical depiction, for simplicity, less than 4 h was graphed as 4, and 10 or more hours was graphed as 10 h.

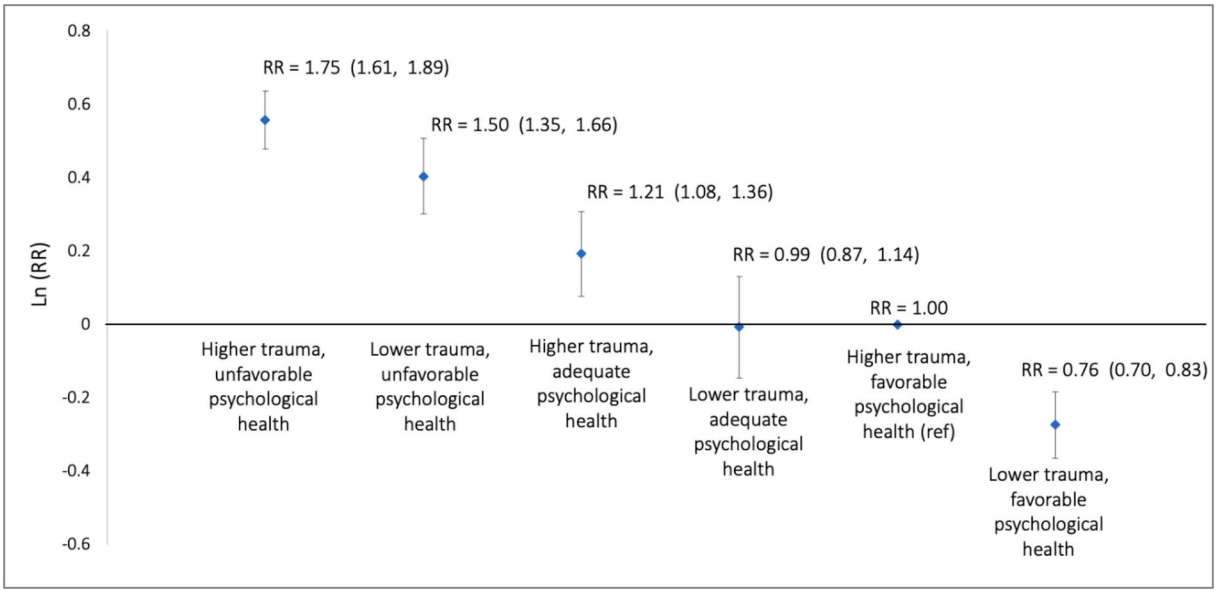

Fig. 2. Adjusted risk ratios graphed on the natural log scale for pre-pandemic psychological resilience in relation to reporting less sleep since the start of the pandemic, compared to no change in sleep amount, among women with trauma history in the Nurses' Health Study II (n = 14,755).
Ln = natural log. RR = risk ratio. Models are adjusted for age, race, education, marital status, chronic conditions, living arrangement, quartile of census tract median income, and sleep duration in 2017.

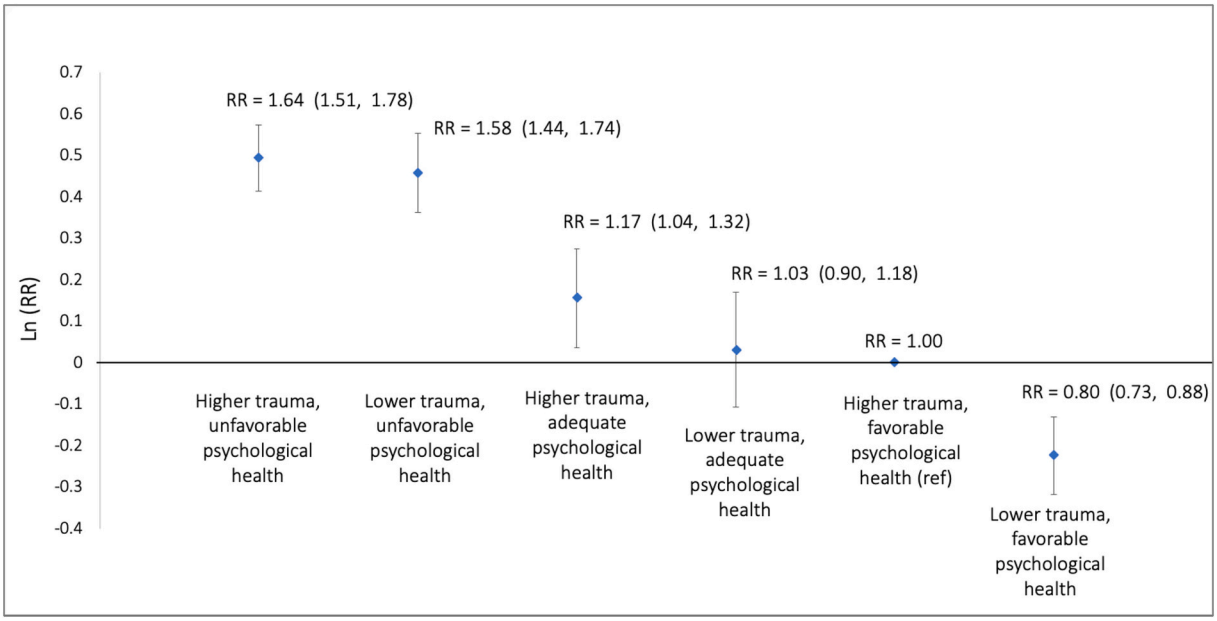

Fig. 3. Adjusted risk ratios graphed on the natural log scale for pre-pandemic psychological resilience in relation to reporting fairly bad or very bad sleep quality compared to fairly good or very good sleep quality at the start of the pandemic, among 18,396 women with trauma history in the Nurses' Health Study II.
Ln = natural log. RR = risk ratio. Model is adjusted for age, race, education, marital status, chronic conditions, living arrangement, quartile of census tract median income, and sleep quality in 2017.

2.21, 2.91). Having lower trauma/favorable psychological health was associated with nearly the same risk as the most resilient group (the exposure reference group) of being in the long sleep duration trajectory (i.e., no relationship; RR: 0.99; 95 % CI: 0.85, 1.16), but it showed a protective risk ratio against being in the short sleep duration trajectory (RR: 0.82; 95 % CI: 0.71, 0.93).

3.4. Potential effect modification by healthcare worker status

When stratifying by frontline health care worker status in May 2020 (the first pandemic-related survey), we observed the same patterns for the relationships between pre-pandemic resilience and all three types of sleep outcomes in both groups (Tables S2-S5), suggesting no substantial effect modification by this variable. For example, among frontline healthcare workers, being in the lower trauma/favorable psychological health group was associated with lower risk of reporting fairly bad or very bad sleep quality at the start of the pandemic (RR: 0.72; 95 % CI: 0.61, 0.84), similar to the risk ratio for this same resilience group among the non-frontline healthcare workers (RR: 0.85; 95 % CI: 0.75, 0.95), with overlapping confidence intervals (Table S2). Similarly, both

Table 2
Adjusted odds ratios from multinomial model for pre-pandemic psychological resilience in relation to trajectory group membership, among 18,541 women with trauma history in the Nurses' Health Study II.

Resilience group (exposure; ref. = higher trauma, favorable psychological health)	Trajectory group (outcome; ref. = healthy sleep duration)	Odds ratio	95 % confidence interval
Higher trauma, unfavorable psychological health	Long duration group	1.87	(1.57, 2.23)
	Average duration group	1.23	(1.11, 1.37)
	Short duration group	2.53	(2.21, 2.91)
Lower trauma, unfavorable psychological health	Long duration group	1.77	(1.42, 2.21)
	Average duration group	0.98	(0.85, 1.13)
	Short duration group	2.06	(1.72, 2.45)
Higher trauma, adequate psychological health	Long duration group	1.46	(1.16, 1.84)
	Average duration group	1.04	(0.91, 1.19)
	Short duration group	1.74	(1.45, 2.08)
Lower trauma, adequate psychological health	Long duration group	0.96	(0.71, 1.29)
	Average duration group	1.31	(1.13, 1.52)
	Short duration group	1.54	(1.25, 1.90)
Lower trauma, favorable psychological health	Long duration group	0.99	(0.85, 1.16)
	Average duration group	1.00	(0.92, 1.08)
	Short duration group	0.82	(0.71, 0.93)

ref = reference group. Model is adjusted for age, race, education, marital status, chronic conditions, living arrangement, and quartile of census tract median income.

frontline healthcare workers and non-frontline healthcare workers had elevated risk ratios for the lower resilience groups and this same outcome (e.g., higher trauma/unfavorable psychological health RR: 1.49; 95 % CI: 1.30, 1.70 for frontline healthcare workers and RR: 1.73; 95 % CI: 1.56, 1.91 for non-frontline or former healthcare workers; Table S2).

4. Discussion

In our study of 18,670 middle-aged and older women, we observed strong and consistent relationships between pre-pandemic resilience to trauma and sleep outcomes early in the pandemic, indicating that higher psychological resilience may promote healthier sleep duration patterns and better-quality sleep even during times of collective stress. Lower levels of resilience were associated with three separate outcomes: decreased sleep at the start of the pandemic, worse sleep quality, and with stable yet more extreme sleep duration over time (i.e., either shorter or longer duration than recommended). Perhaps most importantly, women in the most resilient group (high trauma burden but favorable psychological health) had better sleep quality and healthier sleep duration than almost every other group and were comparable to the group with low trauma burden and favorable psychological health. In other words, women who experienced higher trauma but had favorable psychological health had substantially healthier sleep patterns than women with either lower trauma and unfavorable psychological health or those with higher trauma but only adequate psychological health – suggesting that trauma alone is not driving poorer subsequent health. These findings are encouraging and suggest that the maintenance of psychological health in the face of trauma may produce downstream positive effects on biobehavioral factors and potentially later physical health as well.

Resilience to trauma is likely influenced by multiple intrapersonal and contextual factors (e.g., socioeconomic assets and community support in addition to learned coping skills). Individuals who have experienced trauma and are functioning well likely had high social support and/or learned important coping and self-regulation skills that they are now able to draw on in the face of future stressors. In this way, women in the higher resilience groups may have been able to better regulate their sleep or cope with sleep changes early on in the COVID-19 pandemic. Despite differences in how we conceptualized resilience, our findings are consistent with prior research that has shown higher trait resilience to be associated with healthy sleep duration among older women [16]. There is ongoing discussion and debate about which measures of resilience best capture the underlying construct of interest, and our results add an additional perspective to this literature.

Although we hypothesized in our exploratory aim that the relationship between resilience and sleep might differ for active healthcare workers, we observed no meaningful effect modification by healthcare worker status. This may indicate that resilience is evident across multiple settings, both in the workplace on the frontline and not. One other explanation for this finding could be that women in this cohort who were still working (mean age = 62 at the time of the PTSD survey) may be healthier on average, which may mask a relationship between resilience and sleep, despite being exposed to potentially harrowing working conditions.

Recently, the American Heart Association added sleep as an important heart health indicator, acknowledging that poor sleep is a risk factor for multiple negative long-term physical health problems, including cardiovascular disease and type II diabetes [44]. Sleep may be particularly important for older adults who may be more susceptible to illnesses, and for women, who are more likely to report poor sleep than men. Although we were able to control for pre-existing conditions in our analysis, future research could examine in more detail how long or short sleep may be differentially related to pre-existing conditions (e.g. hypertension), or potentially be part of a causal pathway linking psychological resilience, sleep and long-term health outcomes such as cardiovascular disease. There may also be a bidirectional relationship between resilience and sleep quality and duration, and this bidirectionality warrants further investigation. Additionally, both sleeping *too much* (i.e., having a "long" sleep duration trajectory over time) and sleeping *too little* (having a short sleep duration trajectory) compared to recommended or average levels may be indicative of poor health. However, only 7 % of our sample fell into the "long sleep" trajectory, and their average sleep levels are still considered healthy (8.5–9.5 h per 24-h period). Studies in other samples may wish to further investigate longer sleep patterns.

4.1. Strengths and limitations

Our study has multiple strengths; we were able to examine the relationship between pre-pandemic resilience to trauma and different types of sleep outcomes prospectively, and to examine sleep trajectories over a period of several years, including pre-pandemic measurement. This prospective design is strengthened by our large sample size and well-characterized longitudinal cohort. Our findings provide insight into sleep patterns among healthcare workers during a highly stressful period, the COVID-19 pandemic- an area where longitudinal data is particularly rare. Our measurement of resilience is a comprehensive, categorical outcome-based measure, as we were able to include multiple critical elements of the construct, such as trauma burden, psychological distress, and favorable psychological health, all assessed prior to the start of the pandemic, reducing concerns about recall bias. This measurement of resilience also fills a gap in the existing literature on resilience and sleep, which has historically used trait measures rather than outcome-based measures of resilience.

Our findings may be susceptible to misclassification, as our measures of trauma history, psychological health, and sleep are self-reported. Although trauma data are almost always self-reported, future research should consider including objective sleep data (e.g., wearables). However, prior work in this cohort has established links between self-reported sleep and objective health outcomes, including type 2 diabetes and sleep apnea [5], suggesting that self-reported sleep is a key indicator of health. In the Nurses' Health Study 3 (a younger cohort of nurses), self-reported sleep measures have been validated against objective measures of sleep (Fitbits) [45]. As a second limitation, we lack sleep data between 2017 and the beginning of the pandemic; it would be ideal to have more frequently assessed sleep duration during those time periods, particularly to better understand reported changes to sleep duration at the start of the pandemic. As a third limitation, we dichotomized trauma and well-being variables in the absence of clearly validated cut-offs; future research may be able to use continuous measures to capture greater variability in responses, or to measure severity or duration of traumatic experiences, which we were unable to do in this study. Fourth, we were not able to adjust our analyses for COVID-19 infection because testing was limited early in the pandemic, but investigation of the effect of COVID-19 infection on the relationship between resilience and sleep is warranted in future studies. There may also be residual confounding from factors like financial stress and prior substance or medication use. Finally, our sample comprised primarily white, older, professional women—albeit at an extremely stressful time for healthcare workers—and thus may not be generalizable to other gender diverse, age diverse, or ethnically diverse samples.

Future work, in addition to sampling from more ethnically diverse populations, should explore potential sleep effects of changes over time in resilience, as well as more long-term changes in sleep, measured farther out from the pandemic or other times of collective distress. It would also be useful to incorporate details of prior trauma like intensity, duration, and specific nature of the trauma, beyond number of traumatic event types, and how those characteristics may impact both resilience and sleep outcomes.

5. Conclusion

Our findings could inform both prevention and intervention efforts. In addition to working to prevent trauma exposure in the first place, resilience to trauma that does occur can be fostered and bolstered at individual and community levels. Sleep is also intervenable, and fostering both resilience to trauma and healthy sleep duration and quality may serve to improve long-term physical health and prevent negative cardiometabolic outcomes. Ultimately, our findings spotlight the importance of intervening to improve psychological health following trauma exposure and provide additional evidence that harmful sequelae from trauma are not inevitable.

CRediT authorship contribution statement

Laura Sampson: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Arielle A.J. Scoglio:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Kristen Nishimi:** Writing – review & editing, Methodology. **Karmel W. Choi:** Writing – review & editing, Methodology. **Ariel H. Kim:** Writing – review & editing, Visualization, Validation. **Yiwen Zhu:** Writing – review & editing, Methodology. **Qi Sun:** Writing – review & editing, Supervision, Conceptualization. **Jae Hee Kang:** Writing – review & editing, Project administration, Data curation. **Eric B. Rimm:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Karestan C. Koenen:** Writing – review & editing, Supervision, Funding acquisition. **Laura D. Kubzansky:** Writing – review & editing, Supervision, Methodology, Funding acquisition.

Declaration of competing interest

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Appendix A. Supplementary data

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References

[1] F. Diaz, T. Cornelius, S. Bramley, H. Venner, K. Shaw, M. Dong, P. Pham, C. L. McMurry, D.E. Cannone, A.M. Sullivan, S.A.J. Lee, J.E. Schwartz, A. Shechter, M. Abdalla, The association between sleep and psychological distress among new York City healthcare workers during the COVID-19 pandemic, J. Affect. Disord. 298 (Pt A) (2022) 618–624, https://doi.org/10.1016/j.jad.2021.10.033.

[2] B. Zhang, Y.K. Wing, Sex differences in insomnia: a meta-analysis, Sleep 29 (1) (2006) 85–93, https://doi.org/10.1093/sleep/29.1.85.

[3] A.T. Gargiulo, L.M. Peterson, L.A. Grafe, Stress, coping, resilience, and sleep during the COVID-19 pandemic: a representative survey study of US adults, Brain Behav. 11 (11) (2021) e2384, https://doi.org/10.1002/brb3.2384.

[4] J. Breslau, M.L. Finucane, A.R. Locker, M.D. Baird, E.A. Roth, R.L. Collins, A longitudinal study of psychological distress in the United States before and during the COVID-19 pandemic, Prev. Med. 143 (2021) 106362, https://doi.org/10.1016/j.ypmed.2020.106362.

[5] M.Y. Baden, F.B. Hu, C. Vetter, E. Schernhammer, S. Redline, T. Huang, Sleep duration patterns in early to middle adulthood and subsequent risk of type 2 diabetes in women, Diabetes Care 43 (6) (2020) 1219–1226, https://doi.org/10.2337/dc19-2371.

[6] F.P. Cappuccio, L. D'Elia, P. Strazzullo, M.A. Miller, Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies, Sleep 33 (5) (2010) 585–592, https://doi.org/10.1093/sleep/33.5.585.

[7] D.J. Gottlieb, N.M. Punjabi, A.B. Newman, H.E. Resnick, S. Redline, C.M. Baldwin, F.J. Nieto, Association of sleep time with diabetes mellitus and impaired glucose tolerance, Arch. Intern. Med. 165 (8) (2005) 863–867, https://doi.org/10.1001/archinte.165.8.863.

[8] M.P. St-Onge, M.A. Grandner, D. Brown, M.B. Conroy, G. Jean-Louis, M. Coons, D. L. Bhatt, Sleep duration and quality: impact on lifestyle behaviors and cardiometabolic health: a scientific statement from the American Heart Association, Circulation 134 (18) (2016) e367–e386, https://doi.org/10.1161/cir.0000000000000444. , Nov 1.

[9] American Diabetes Association, Classification and diagnosis of diabetes: standards of medical care in Diabetes-2019, Diabetes Care 42 (Suppl. 1) (2019) S13–s28, https://doi.org/10.2337/dc19-S002.

[10] A. Beaman, M.C. Bhide, A.W. McHill, S.S. Thosar, Biological pathways underlying the association between habitual long-sleep and elevated cardiovascular risk in adults, Sleep Med. 78 (2021) 135–140, https://doi.org/10.1016/j.sleep.2020.12.011.

[11] M.J. Butler, T.M. Spruill, D.A. Johnson, S. Redline, M. Sims, B.C. Jenkins, J. N. Booth 3rd, S.J. Thomas, M. Abdalla, E.C. O'Brien, R.J. Mentz, G. Ogedegbe, N. J. Williams, Suboptimal sleep and incident cardiovascular disease among African Americans in the Jackson heart study (JHS), Sleep Med. 76 (2020) 89–97, https://doi.org/10.1016/j.sleep.2020.09.005.
[12] S. Pappa, N. Sakkas, E. Sakka, A year in review: sleep dysfunction and psychological distress in healthcare workers during the COVID-19 pandemic, Sleep Med. 91 (2022) 237–245, https://doi.org/10.1016/j.sleep.2021.07.009.
[13] K.A. McLaughlin, K.J. Conron, K.C. Koenen, S.E. Gilman, Childhood adversity, adult stressful life events, and risk of past-year psychiatric disorder: a test of the stress sensitization hypothesis in a population-based sample of adults, Psychol. Med. 40 (10) (2010) 1647–1658, https://doi.org/10.1017/s0033291709992121.
[14] K.M. Connor, J.R. Davidson, Development of a new resilience scale: the Connor-Davidson resilience scale (CD-RISC), Depress. Anxiety 18 (2) (2003) 76–82, https://doi.org/10.1002/da.10113.
[15] T. Kelley, J. Pransky, Principles for realizing resilience: a new view of trauma and inner resilience, J. Traum. Stress Disord. Treat. 02 (2013), https://doi.org/10.4172/2324-8947.1000102.
[16] S. Springfield, F. Qin, H. Hedlin, C.B. Eaton, M.C. Rosal, H. Taylor, U. M. Staudinger, M.L. Stefanick, Resilience and CVD-protective health behaviors in older women: examining racial and ethnic differences in a cross-sectional analysis of the Women's Health Initiative, Nutrients 12 (7) (2020), https://doi.org/10.3390/nu12072107. , Jul 16.
[17] S.F. Cal, L.R. Sá, M.E. Glustak, M.B. Santiago, Resilience in chronic diseases: a systematic review, Cogent Psychol. 2 (1) (2015) 1024928, https://doi.org/10.1080/23311908.2015.1024928.
[18] J.W. Park, R. Mealy, I.J. Saldanha, E.B. Loucks, B.L. Needham, M. Sims, J.L. Fava, A.J. Dulin, C.J. Howe, Multilevel resilience resources and cardiovascular disease in the United States: a systematic review and meta-analysis, Health Psychol. 41 (4) (2022) 278–290, https://doi.org/10.1037/hea0001069.
[19] Q.G. To, C. Vandelanotte, K. Cope, S. Khalesi, S.L. Williams, S.J. Alley, T. L. Thwaite, A.S. Fenning, R. Stanton, The association of resilience with depression, anxiety, stress and physical activity during the COVID-19 pandemic, BMC Public Health 22 (1) (2022) 491, https://doi.org/10.1186/s12889-022-12911-9.
[20] G.A. Bonanno, E.D. Diminich, Annual research review: positive adjustment to adversity–trajectories of minimal-impact resilience and emergent resilience, J. Child Psychol. Psychiatry 54 (4) (2013, Apr) 378–401, https://doi.org/10.1111/jcpp.12021.
[21] S.S. Luthar, D. Cicchetti, B. Becker, The construct of resilience: a critical evaluation and guidelines for future work, Child Dev. 71 (3) (2000) 543–562, https://doi.org/10.1111/1467-8624.00164.
[22] K.W. Choi, K. Nishimi, S.C. Jha, L. Sampson, J. Hahn, J.H. Kang, K.C. Koenen, L. D. Kubzansky, Pre-pandemic resilience to trauma and mental health outcomes during COVID-19, Soc. Psychiatry Psychiatr. Epidemiol. 58 (3) (2023) 453–465, https://doi.org/10.1007/s00127-022-02367-y.
[23] H.R. Winefield, T.K. Gill, A.W. Taylor, R.M. Pilkington, Psychological well-being and psychological distress: is it necessary to measure both? Psychol. Well-Being Theory Res. Pract. 2 (1) (2012) 3, https://doi.org/10.1186/2211-1522-2-3.
[24] C. Du, M.C. Zan, M.J. Cho, J.I. Fenton, P.Y. Hsiao, R. Hsiao, L. Keaver, C.-C. Lai, H. Lee, M.-J. Ludy, W. Shen, W.C. Swee, J. Thrivikraman, K.-W. Tseng, W.-C. Tseng, S. Doak, S.Y. Folk, R.M. Tucker, The effects of sleep quality and resilience on perceived stress, dietary behaviors, and alcohol misuse: a mediation-moderation analysis of higher education students from Asia, Europe, and North America during the COVID-19 pandemic, Nutrients 13 (2) (2021).
[25] M.L. Voss, C.L. Currie, Sleep quality and the importance women place on healthy eating interact to influence psychological resilience, Am. J. Health Behav. 46 (3) (2022) 285–293.
[26] A.A.J. Scoglio, K.W. Choi, K. Nishimi, L. Sampson, K. Koenen, A.L. Roberts, S. Jha, L.D. Kubzansky, Pre-pandemic resilience to trauma & covid-19 infection in older women, Psychosom. Med. (2024), https://doi.org/10.1097/psy.0000000000001304.
[27] L. Sampson, S.C. Jha, A.L. Roberts, R.B. Lawn, K.M. Nishimi, A. Ratanatharathorn, J.A. Sumner, J.H. Kang, L.D. Kubzansky, E.B. Rimm, K.C. Koenen, Trauma, post-traumatic stress disorder, and treatment among middle-aged and older women in the Nurses' health study II, Am. J. Geriatr. Psychiatry 30 (5) (2022) 588–602, https://doi.org/10.1016/j.jagp.2021.10.017.
[28] K.M. Nishimi, K.C. Koenen, B.A. Coull, R. Chen, L.D. Kubzansky, Psychological resilience predicting cardiometabolic conditions in adulthood in the midlife in the United States study, Proc. Natl. Acad. Sci. 118 (32) (2021) e2102619118, https://doi.org/10.1073/pnas.2102619118.
[29] P. Schnurr, M. Vielhauer, F. Weathers, The Brief Trauma Questionnaire (BTQ), National Center for PTSD, 1999. https://www.ptsd.va.gov/professional/assessment/documents/BTQ.pdf.
[30] M. Kaspersen, S.B. Matthiesen, K.G. Götestam, Social network as a moderator in the relation between trauma exposure and trauma reaction: a survey among UN soldiers and relief workers, Scand. J. Psychol. 44 (5) (2003) 415–423, https://doi.org/10.1046/j.1467-9450.2003.00362.x.
[31] T.M. Moore, V.B. Risbrough, D.G. Baker, G.E. Larson, D.E. Glenn, C.M. Nievergelt, A. Maihofer, A.M. Port, C.T. Jackson, K. Ruparel, R.C. Gur, Effects of military service and deployment on clinical symptomatology: the role of trauma exposure and social support, J. Psychiatr. Res. 95 (2017) 121–128, https://doi.org/10.1016/j.jpsychires.2017.08.013.
[32] S. Hamby, J.H.L. Elm, K.H. Howell, M.T. Merrick, Recognizing the cumulative burden of childhood adversities transforms science and practice for trauma and resilience, Am. Psychol. 76 (2) (2021) 230–242, https://doi.org/10.1037/amp0000763.
[33] A.K. Ruork, C.L. McLean, A.E. Fruzzetti, It happened matters more than what happened: associations between intimate partner violence abuse type, emotion regulation, and post-traumatic stress symptoms, Viol. Against Women 28 (5) (2022) 1158–1170, https://doi.org/10.1177/10778012211013895.
[34] E.M. Andresen, J.A. Malmgren, W.B. Carter, D.L. Patrick, Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale), Am. J. Prev. Med. 10 (2) (1994) 77–84. , Mar-Apr.
[35] C.A. Blevins, F.W. Weathers, M.T. Davis, T.K. Witte, J.L. Domino, The posttraumatic stress disorder checklist for DSM-5 (PCL-5): development and initial psychometric evaluation, J. Trauma. Stress. 28 (6) (2015) 489–498, https://doi.org/10.1002/jts.22059.
[36] F.W. Weathers, B.T. Litz, T.M. Keane, P.A. Palmieri, B.P. Marx, P.P. Schnurr, The PTSD Checklist for DSM-5 (PCL-5), National Center for PTSD, 2013. https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp.
[37] P. Jordan, M.C. Shedden-Mora, B. Löwe, Psychometric analysis of the generalized anxiety disorder scale (GAD-7) in primary care using modern item response theory, PLoS ONE 12 (8) (2017) e0182162, https://doi.org/10.1371/journal.pone.0182162.
[38] E. Diener, R.A. Emmons, R.J. Larsen, S. Griffin, The satisfaction with life scale, J. Pers. Assess. 49 (1) (1985) 71–75, https://doi.org/10.1207/s15327752jpa4901_13.
[39] M.F. Scheier, C.S. Carver, M.W. Bridges, Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the life orientation test, J. Pers. Soc. Psychol. 67 (6) (1994) 1063–1078, https://doi.org/10.1037//0022-3514.67.6.1063.
[40] C.D. Ryff, C.L. Keyes, The structure of psychological well-being revisited, J. Pers. Soc. Psychol. 69 (4) (1995) 719–727, https://doi.org/10.1037//0022-3514.69.4.719.
[41] B.L. Jones, D.S. Nagin, Advances in group-based trajectory modeling and an SAS procedure for estimating them, Sociol. Methods Res. 35 (4) (2007) 542–571, https://doi.org/10.1177/0049124106292364.
[42] B.L. Jones, D.S. Nagin, K. Roeder, A SAS procedure based on mixture models for estimating developmental trajectories, Sociol. Methods Res. 29 (3) (2001) 374–393. https://EconPapers.repec.org/RePEc:sae:somere:v:29:y:2001:i:3:p:374-393.
[43] National Heart, Lung, and Blood Institute (NHLBI). How Sleep Works: How much sleep is enough?, 2022. https://www.nhlbi.nih.gov/health/sleep/how-much-sleep#:~:text=Experts%20recommend%20that%20adults%20sleep,or%20more%20hours%20a%20night.
[44] American Heart Association Presidential Advisory. (2022). American Heart Association Adds Sleep to Cardiovascular Health Checklist. https://newsroom.heart.org/news/american-heart-association-adds-sleep-to-cardiovascular-health-checklist#:~:text=The%20new%20sleep%20metric%20suggests,for%20children%20depending%20on%20age.
[45] R. Fore, J.E. Hart, C. Choirat, J.W. Thompson, K. Lynch, F. Laden, J.E. Chavarro, P. James, Embedding Mobile health technology into the Nurses' health study 3 to study behavioral risk factors for cancer, Cancer Epidemiol. Biomarkers Prev. 29 (4) (2020) 736–743, https://doi.org/10.1158/1055-9965.Epi-19-1386.