Physical, psychological and occupational consequences of job burnout: A systematic review of prospective studies

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Abstract

Burnout is a syndrome that results from chronic stress at work, with several consequences to workers’ well-being and health. This systematic review aimed to summarize the evidence of the physical, psychological and occupational consequences of job burnout in prospective studies. The PubMed, Science Direct, PsycInfo, SciELO, LILACS and Web of Science databases were searched without language or date restrictions. The Transparent Reporting of Systematic Reviews and Meta-Analyses guidelines were followed. Prospective studies that analyzed burnout as the exposure condition were included. Among the 993 articles initially identified, 61 fulfilled the inclusion criteria, and 36 were analyzed because they met three criteria that must be followed in prospective studies. Burnout was a significant predictor of the following physical consequences: hypercholesterolemia, type 2 diabetes, coronary heart disease, hospitalization due to cardiovascular disorder, musculoskeletal pain, changes in pain experiences, prolonged fatigue, headaches, gastrointestinal issues, respiratory problems, severe injuries and mortality below the age of 45 years. The psychological effects were insomnia, depressive symptoms, use of psychotropic and antidepressant medications, hospitalization for mental disorders and psychological ill-health symptoms. Job dissatisfaction, absenteeism, new disability pension, job demands, job resources and presenteeism were identified as professional outcomes. Conflicting findings were observed. In conclusion, several prospective and high-quality studies showed physical, psychological and occupational consequences of job burnout. The individual and social impacts of burnout highlight the need for preventive interventions and early identification of this health condition in the work environment.
Introduction

Working conditions have a well-known impact, either positive or negative, on employees’ health [1]. Adverse working conditions may lead to job burnout, a syndrome resulting from chronic stress at work that is characterized by overwhelming exhaustion, negative attitudes or a lack of commitment with clients and dissatisfaction with job performance. This process may lead to undesirable consequences for workers, their families, the work environment and the organizations [2]. From the psychosocial perspective, the following three dimensions of burnout have been described: a) emotional exhaustion, characterized by emotional depletion and loss of energy; b) depersonalization or cynicism, also described as dehumanization, detachment from work and clients and emotional hardening; and c) reduced personal accomplishment or inefficacy, that is, a feeling of personal or professional inadequacy as well as reduced productivity and coping skills [3, 4].

Cross-sectional studies have shown associations between burnout and some health problems, such as increased alcohol consumption [5], sleep disorders [6] depression [7], sedentarism, obesity [8] and musculoskeletal pain [9]. However, well-conducted prospective studies are more appropriate for investigating the possible consequences of this syndrome, because these types of studies enable the identification of the temporal relationship between the exposure (burnout syndrome) and the outcomes (consequences).

We found only two systematic reviews that have investigated burnout and its possible consequences in working populations. One selected only studies published in English between 1988 and 2008, examined only job satisfaction and turnover intention among North-American psychotherapists and included only studies with a cross-sectional design [10]. The other focused on nurses and investigated the relationships of burnout, job satisfaction and general health in findings from 70 studies published in English between 1990 and 2012; the majority of these (68 studies) were also cross-sectional studies [11].

Therefore, this systematic review aimed to summarize the evidence of the physical, psychological and occupational consequences of job burnout in prospective studies.

Materials and methods

This study is a systematic review that followed the guidelines of the Transparent Reporting of Systematic Reviews and Meta-Analyses–S1 Appendix [12] (PROSPERO Register: CRD42015028047). We searched the PubMed (U.S. National Library of Medicine), Science Direct (Elsevier), PsycInfo (American Psychological Association), SciELO (Scientific Electronic Library Online), LILACS (Literature in the Health Sciences in Latin America and the Caribbean) and Web of Science databases through May 31, 2017, without restrictions on language or year of publication.

Search strategy

The following terms were used to identify publications on burnout with a prospective design: “burnout”, “longitudinal”, “prospective”, “cohort”, “case control”, “case-control”, “follow-up”, and “follow up”. These terms were combined with Boolean operators according to the rules of each database (S2 Appendix). To complement the database searches, we reviewed all the references of the selected articles and those of review articles.

Inclusion and exclusion criteria

The inclusion criteria were as follows: the study was an original study published in a journal with an editorial board and peer review; and the study was a prospective study investigating
burnout as the exposure (independent variable) for the occurrence of physical, psychological or occupational consequences (dependent variables).

We excluded studies of non-working populations (i.e., studies with twins, patients and students, including medical, sports and high school students), editorials, commentaries, letters to editors, abstracts, literature reviews, qualitative studies, studies that reported only a cross-sectional analysis, trials, studies that reported research method or instrument validation, and follow-up studies that did not have a comparison group (unexposed to burnout) or treated burnout as an outcome (dependent variable).

Selection and extraction of the articles
The selection of the studies was performed independently by two of the authors using the following three steps: (a) analyzing the articles’ titles, (b) reading the abstracts, and (c) reading the full texts. At each step, if there were divergences, a third author was asked to judge, and the final decision was made by consensus or majority. After selection of the studies, the data of interest were registered in a standardized spreadsheet.

Evaluating the methodological quality of the studies
Although several tools for evaluating the susceptibility to bias in observational epidemiological studies are available, no consensus has been reached on a gold standard for this purpose [13, 14]. Moreover, many of these tools have been criticized either because their validity and reliability have not been reported [15, 16] or because of low agreement between reviewers and authors [17] or between reviewers [18]. Therefore, we analyzed several of these tools [19–22] as well as another tool related to adequate reporting of observational epidemiological studies [23]. Based on the conclusions of that analysis, we decided to follow the recommendations of epidemiology experts [24, 25] for conducting sound and reliable prospective studies and only considered studies that met three central methodological criteria (Fig 1) for internal validity. These criteria were related to the selection of participants (ensuring that those with the outcome already present at the baseline study were excluded), the attrition from the baseline study to the end of follow-up and adjustments for the main confounders.

The first criterion was chosen because, in cohort studies, the exposed and unexposed groups are followed in order to compare the incidence (new cases) of the outcome in both groups; therefore, cases already present at baseline should be excluded [25]. However, we included studies that controlled for the outcome in the analysis of follow-up time. Additionally, changes in the levels of the outcome over time (from baseline to the end of the follow-up time) were considered incident events.

1. The outcome was investigated in the baseline study, and it was excluded or controlled for in the prospective analysis;
2. The response rate was above 50%, and/or there was a comparison of characteristics of respondents and non-respondents that indicated that there was no selection bias;
3. Analyses were minimally adjusted for age or health conditions of the participants.

Fig 1. Evaluation criteria of the methodological quality of the studies.

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The response rate or loss to follow-up is another relevant aspect to be considered in epidemiological studies, as non-respondents or those lost to follow-up in a cohort study may differ in several characteristics from those who respond or are successfully observed during the time in which the study is conducted. These differences include whether the respondents were exposed to the hypothesized risk factor and whether they have a higher/lower risk of presenting the outcome at the end of the follow-up period [26]. Therefore, the second criterion was chosen to prevent the inclusion of studies that were susceptible to selection bias [24, 26].

As we investigated consequences of burnout, the third criterion was chosen because age and/or health conditions are important factors that may confound the associations [24]. Therefore, only studies that reported minimal control for age or for health conditions were analyzed.

Data organization and presentation
The results are presented in tables according to the nature of the consequence: physical, psychological or occupational. When two types of consequences were reported by the same study, they were presented twice in their respective tables. The characteristics of the selected studies (authors, year of publication, country, cohort’s name, working population, follow-up period, burnout instrument, burnout measure, type of dependent variable and outcome measure) are presented in alphabetical order by the first authors’ surnames. The consequences were put in order according to their type and subtype (e.g., organic system), and the tables describe the final sample, the dependent variable (investigated consequence), the main significant and non-significant findings, and the control variables used in the analyses.

Results
Search for and selection of studies
We identified 993 articles in the databases that were searched; 343 were duplicated. After reading the titles and abstracts, 529 were excluded. Among the 121 remaining articles, we excluded 63 after reading the full text. We then added three studies listed in the references of the selected studies, resulting in a final sample of 61 articles (Fig 2).

Methodological quality evaluation
Among the 61 selected studies [27–87], 36 met all three methodological quality criteria (S3 Appendix). The main characteristics of the articles that did not meet our predefined quality criteria can be viewed in S4 Appendix.

Characteristics of the included studies
From here on, only the characteristics and results of the 36 studies that met all three quality criteria will be presented (Table 1) and discussed. All studies were prospective cohorts; 12 reported physical consequences, 10 reported psychological consequences and 12 reported occupational consequences. Two articles analyzed physical and psychological consequences. The studies were mainly conducted in Europe, particularly in Nordic countries (21 studies). The only other regions of the world in which the studies were conducted were Asia (Israel, China and Japan), South Africa and the United States. Several occupations were investigated, such as dentists, forest industry employees, nurses, teachers, human service workers and financial services’ employees. The Maslach Burnout Inventory (MBI) and the Shirom-Melamed Burnout Measure (SMBM) were the primary tools used to investigate burnout. Most authors treated burnout as a continuous variable, while some authors treated burnout as dichotomous
and others divided it into three categories. The number of participants varied from 133 [62] to 10,062 [31]. Follow-up time ranged from one year for several outcomes [47, 48, 51, 55, 62, 68, 83] to 12 years for the outcome use of psychotropic and antidepressant medications [60]. With the exception of one study [32], all studies were published between the years 2005 and 2016. Only one study was not reported in English [47].

Physical consequences

The most frequently investigated physical outcomes were cardiovascular diseases (coronary heart disease (CHD) and hospitalization for cardiovascular diseases) and risk factors for these diseases (obesity, hyperlipidemia, type 2 diabetes, large waist circumference (WC), high body mass index (BMI), metabolic syndrome, hypertension, high triglycerides, low HDL cholesterol, high LDL cholesterol, and impaired fasting glucose) (Table 2).

Burnout was a significant predictor of hypercholesterolemia (total cholesterol ≥220 mg/dl) [59] and type 2 diabetes [65], independently of confounding variables. Burnout was also associated with low HDL cholesterol in a model adjusted for age; however, this association lost significance when additionally adjusted for alcohol consumption, smoking and physical activity [59].
| AUTHORS, YEAR, COUNTRY | COHORT NAME | WORKING POPULATION | FOLLOW-UP PERIOD | BURNOUT INVENTORY | BURNOUT MEASURE | DEPENDENT VARIABLE | OUTCOME MEASURE |
|------------------------|-------------|--------------------|-----------------|-------------------|-----------------|---------------------|----------------|
| Ahola et al., 2007 -Finland [27] | Not identified | Dentists | 3 years | Maslach Burnout Inventory (MBI) | A sum score, in which exhaustion, cynicism, and lack of professional efficacy have different weights (0.4×exhaustion +0.3×cynicism+0.3×lack of professional efficacy). Burnout was categorized as follows: no burnout (scores 0–1.49), mild burnout (scores 1.50–3.49), and severe burnout (scores 3.50–6) | Depressive symptoms | Beck Depression Inventory (BDI) |
| Ahola et al., 2009 -Finland [28] | Health 2000 Study | Employees randomly selected | 4 years | MBI | A sum score, in which exhaustion, cynicism, and lack of professional efficacy have different weights (0.4×exhaustion +0.3×cynicism+0.3×lack of professional efficacy). Burnout was categorized as follows: no burnout (scores 0–1.49), mild burnout (scores 1.50–3.49), and severe burnout (scores 3.50–6) | New disability pension | Records of the Social Insurance Institution of Finland and the Finnish Centre for Pensions |
| Ahola et al., 2009 -Finland [29] | Still Working Cohort Stud | Forest industry employees | 8 years | MBI | A sum score, in which exhaustion, cynicism, and lack of professional efficacy have different weights (0.4×exhaustion +0.3×cynicism+0.3×lack of professional efficacy). Burnout was categorized as follows: no burnout (scores 0–1.49), mild burnout (scores 1.50–3.49), and severe burnout (scores 3.50–6) | New disability pension | Records of the Social Insurance Institution of Finland and the Finnish Centre for Pensions |
| Ahola et al., 2010 -Finland [30] | Still Working Cohort Study | Forest industry employees | 10 years | MBI | A sum score, in which exhaustion, cynicism, and lack of professional efficacy have different weights (0.4×exhaustion +0.3×cynicism+0.3×lack of professional efficacy) | Mortality | Death certificates from the National Mortality Register |
| Ahola et al., 2013 -Finland [31] | Still Working Cohort Study | Forest industry employees | 8 years | MBI | A sum score, in which exhaustion, cynicism, and lack of professional efficacy have different weights (0.4×exhaustion +0.3×cynicism+0.3×lack of professional efficacy). Burnout was categorized as follows: no burnout (sum score 0 to 1.49) and burnout (sum score 1.50 to 6) | Severe Injuries | Data on deaths from the National Mortality Register. Data on hospital admissions from the National Hospital Discharge Register |
| Appels, Schouten, 1991 Netherlands [32] | Rotterdam Civil Servants Study | Male employees who participated in a voluntary health checkup | 4.2 years | No scale. Burnout was verified by the questions: Have you ever been burned out? "Yes", "?" or "no" | Dichotomous variable (ever burned out, never burned out) | Coronary Heart Disease | Medical diagnosis of cardiac problems registered in a central system. For employees who had left their jobs, a questionnaire during follow-up (self-reported coronary disease, which was then checked by a doctor); death certificates |

(Continued)
| AUTHORS, YEAR | COUNTRY | WORKING POPULATION | BURNOUT INVENTORY | FOLLOW-UP PERIOD | DEPENDENT VARIABLE | OUTCOME MEASURE |
|--------------|---------|---------------------|-------------------|-----------------|-------------------|----------------|
| Armon et al., 2008 -Israel | [33] | Tel Aviv Sourasky Medical Center | SMBM | 1.5 years | Apparentl y healthy employees attending the Center for Periodic Health Examinations | Changes in levels of insomnia |
| Armon et al., 2008 -Israel | [34] | Tel Aviv Sourasky Medical Center | SMBM | 1.5 years | Apparentl y healthy employees attending the Center for Periodic Health Examinations | Changes in levels of insomnia |
| Armon, 2009 -Israel | [35] | Tel Aviv Sourasky Medical Center | SMBM | 1.5 years | Apparentl y healthy employees attending the Center for Periodic Health Examinations | Changes in levels of insomnia |
| Armon et al., 2010 -Israel | [36] | Tel Aviv Sourasky Medical Center | SMBM | 3 years (T1-T2: 18 months, T2-T3: 17 months) | Apparentl y healthy employees attending the Center for Periodic Health Examinations | Musculoskeletal pain |
| Armon et al., 2014 -Israel | [37] | Tel Aviv Sourasky Medical Center | SMBM | 1.5 years | Apparentl y healthy employees attending the Center for Periodic Health Examinations | Changes in levels of insomnia |
| Bianchi et al., 2015 -France | [38] | Not identified | SMBM | 21 months | School teachers | Changes in levels of insomnia |
| Borritz et al., 2006 -Denmark | [39] | PUMA Study Employees (seven different organizations in the human service sector) | CBI | 3 years | Employees | Depressive symptoms |
| Borritz et al., 2010 -Denmark | [40] | PUMA Study Employees (five different organizations in the human service sector) | CBI | 1.5 years | Employees | Long-Term Sickness Absence (>2 weeks) |

- SMBM: Self-Reported Burnout Measure
- MBI: Maslach Burnout Inventory
- CBI: Copenhagen Burnout Inventory
- PHQ-8: Patient Health Questionnaire (8-item depression scale)
- PHQ-9: Patient Health Questionnaire (9-item depression scale)
- DREAM: Danish national register of social transfer payments database (CPR numbers)

**Table 1. (Continued)**
| AUTHORS, COUNTRY | WORKING POPULATION | FOLLOW-UP PERIOD | BURNOUT INVENTORY | BURNOUT MEASURE | OUTCOME MEASURE |
|------------------|--------------------|-----------------|-------------------|----------------|----------------|
| De Beer et al., 2016 - South Africa | Employees from the financial services sector | 3 years (annually) | Not identified | Continuous variable (mean of burnout score) | Psychological Ill-Health Symptoms |
| Demerouti et al., 2009 - Netherlands | Staff nurses in general hospitals | 1.5 year | Not identified | Continuous variable (mean of emotional exhaustion and depersonalization) | Job demands: 5-point Likert and Presenteeism: "Has it happened over the previous 12 months that you felt sick?"
| Figueiredo-Ferraz et al., 2012 - Spain | Nurses of three hospitals | 1 year | Not identified | Continuous variable (mean of emotional exhaustion, depersonalization and professional efficacy) | MBI |
| Grossi et al., 2009 - Sweden | Women employees randomly selected from the general population living in Stockholm County | 1 year | Not identified | Continuous variable (physical fatigue and cognitive difficulties scores) | Quality of Life Questionnaire S20/23 |
| Hallsten et al., 2011 - Sweden | HAKuL Study: Public employees (nurses, healthcare workers, clerical officers, and childcare employees) | 1 year | Not identified | Exhaustion and cynicism items were retained to calculate the core MBI-GS scores. The scores were divided into the following three categories: low ExCy (25th-percentile), medium ExCy (25th-to 75th-percentile), and high ExCy (75th-percentile) | Long-term sickness absence (>60 consecutive days) for each participant, the dates of the first and last day of each spell of sick leave were available in the employees' registers on absences from work |
| Jansson-Frojmark, Lindblom, 2010 - Sweden | Employees randomly selected from the general population | 1 year | Not identified | Burnout was defined as a score of 4.6 or above on the Emotional Exhaustion subscale (low/high), 3.5 or above on the Cynicism subscale (low/high), and 3.6 or below on the Professional Efficacy subscale (low/high) | Incidence and persistence of insomnia (Basic Nordic Sleep Questionnaire) and the Uppsala Sleep Inventory |
| Kim et al., 2011 - USA | Social workers | 3 years (annually) | Not identified | Continuous variable (mean of burnout score) | Physical Health Questionnaire (PHQ) |

**Table 1. (Continued)**
| AUTHORS, YEAR | COHORT NAME | WORKING POPULATION | FOLLOW-UP PERIOD | BURNOUT INVENTORY | BURNOUT MEASURE | DEPENDENT VARIABLE | OUTCOME MEASURE |
|---------------|-------------|-------------------|-----------------|-------------------|----------------|-------------------|-----------------|
| Kitaoka-Higashiguchi et al, 2009 -Japan [59] | Not identified | Male middle managers working for a manufacturing company | 4–5 years | MBI (Japanese Version) | For exhaustion and cynicism, the cut-off point was set between the upper third and the lower two-thirds, and for professional efficacy, the cut-off point was set between the higher two-thirds and the lower third. Subjects with intense exhaustion and either a high level of cynicism or a low level of professional efficacy, or both, were considered to have burnout | | Risk factors for arteriosclerotic disease |
| Leiter et al., 2013 -Finland [60] | Still Working Cohort Study | Forest industry employees | 12 years (T1-T2: 4 years, T2-T3: 8 years) | MBI | Continuous variable (mean of emotional exhaustion and depersonalization; professional efficacy and inconsistency among the dimensions) | Use of psychotropic and antidepressant medications | Data from the National Prescription Register (number of prescriptions) |
| Leone et al., 2009 -Netherlands [61] | Maastricht Cohort Study on Fatigue at Work | Employees from 45 different companies and organizations | 4 years (12-, 24-, and 48-month) | MBI (Dutch Version) | Burnout cases were defined as having a score higher than the 75th percentile on exhaustion and a score higher than the 75th percentile on cynicism or a score lower than the 25th percentile on professional efficacy | Prolonged fatigue | 20-item Checklist Individual Strength (CIS) |
| Lizano, Barak, 2015 -USA [62] | Not identified | Workers of child welfare department | 1 year (two points in time with a 6-month interval) | MBI | Continuous variable (mean of emotional exhaustion and depersonalization) | Job satisfaction | 4-item scale of Quality of Employment Survey |
| Madsen et al., 2015 -Denmark [63] | PUMA Study | Human service workers | 6 years (every 3 years) | CBI | The scores were divided into three categories: low (<25), intermediate (25<score≤50) and high (>50) burnout | Antidepressant treatment | Data from the Danish National Prescription Registry (number of prescriptions) |
| Melamed et al., 2006 -Israel [65] | Not identified | Employees from seven work organizations (two metal factories, two pharmaceutical companies, a textile factory, a food factory and a school) | 3–5 years (mean 3.6 years) | SMBM | Dichotomous variable (high burnout—above the mean score) and continuous variable (mean of score burnout) | Type 2 Diabetes | Based on self-reports of diagnosed and treated type 2 diabetes |
| Melamed, 2009 -Israel [66] | Not identified | Employees from seven work organizations (two metal factories, two pharmaceutical companies, a textile factory, a food factory and a school) | 3–5 years (mean 3.6 years) | SMBM | Continuous variable (mean of burnout score) | Musculoskeletal pain | Reported neck pain, pain in the shoulder region, or lower back pain over the last 12 months |
| AUTHORS, YEAR | COHORT NAME | WORKING POPULATION | FOLLOW-UP PERIOD | BURNOUT INVENTORY | BURNOUT MEASURE | DEPENDENT VARIABLE | OUTCOME MEASURE |
|--------------|-------------|--------------------|------------------|-------------------|----------------|-------------------|------------------|
| Roelen et al., 2015 -Netherlands [68] | Not identified | Employees who participated in an occupational health survey | 1 year | MBI | Continuous variable (mean of exhaustion, cynicism and burnout scores—calculated by summing the scores of exhaustion and cynicism) | Long-term sickness absence—LTSA (>42 consecutive days) | LTSA was medically certified with a diagnostic code of the ICD-10, which was recorded in the occupational health service register |
| Schaufeli et al., 2009 -Netherlands [71] | Not identified | Managers and executives of a Dutch telecom company | 1 year | MBI | Continuous variable (mean of exhaustion and cynicism) | Absence duration (number of sick-leave days between T1 and T2) | Sickness absence records of the employees filed in the database of the company’s occupational health service |
| Shirom et al., 2013 -Israel [74] | Tel Aviv Sourasky Medical Center | Apparently healthy employees attending the Center for Periodic Health Examinations | 2.3 years | SMBM | Continuous variable (mean of burnout score) | Hyperlipidemia | Respondents self-reporting that a physician told them that they had hyperlipidemia |
| Toker et al., 2012 -Israel [77] | Tel Aviv Sourasky Medical Center | Apparently healthy employees attending the Center for Periodic Health Examinations | 7 years (3.6 years on average) | SMBM | Continuous variable (mean of burnout score) and burnout as a dichotomous variable (high—upper most quintile; low burnout—otherwise) | Coronary Heart Disease (CHD) | Participants’ self-reports of medically diagnosed CHD |
| Toker, Biron, 2012 -Israel [78] | Tel Aviv Sourasky Medical Center | Apparently healthy employees attending the Center for Periodic Health Examinations | 3 waves between 2003 and 2009 | SMBM | Continuous variable (mean of burnout score) | Depressive symptoms | Personal Health Questionnaire (PHQ-8) |
| Toppinen-Tanner et al., 2005 -Finland [79] | Still Working Cohort Study | Forest industry employees | 1.8 years | MBI | A sum score, in which exhaustion, cynicism, and lack of professional efficacy have different weights (0.4×exhaustion +0.3×cynicism +0.3×reduced of professional efficacy). The 3 individual components of burnout were analyzed separately and trichotomized as follows: low, medium, and high (divided by terciles) | Sick-Leave Absences ≥3 days absence episodes, medically certified | Company registers (number of episodes and the total number of sick-leave days) |
| Toppinen-Tanner et al., 2009 -Finland [80] | Still Working Cohort Study | Forest industry employees | 10 years | MBI | A sum score, in which exhaustion, cynicism, and lack of professional efficacy have different weights (0.4×exhaustion +0.3×cynicism +0.3×lack of professional efficacy) | Hospitalization for cardiovascular, musculoskeletal and mental disorders | The data was derived from the National Hospital Discharge Register |

(Table 1. Continued)
| AUTHORS, YEAR COUNTRY | COHORT NAME | WORKING POPULATION | FOLLOW-UP PERIOD | BURNOUT INVENTORY | BURNOUT MEASURE | DEPENDENT VARIABLE | OUTCOME MEASURE |
|----------------------|-------------|-------------------|-----------------|-------------------|-----------------|--------------------|----------------|
| Wang et al., 2016 -China [83] | Not identified | Workers at companies specializing in software development, electronic engineering, and agricultural products | 1 year (two points in time with a 6-month interval) | MBI | Continuous variable (mean of burnout score) | Job demands and job resources | Job Content Questionnaire, SWING Questionnaire, Job Diagnostic Survey |

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Table 2. Main findings of longitudinal studies of the physical consequences of burnout.

| AUTHORS, YEAR | N (FINAL SAMPLE) | DEPENDENT VARIABLE | MAIN FINDINGS | CONTROL VARIABLES |
|---------------|------------------|-------------------|---------------|-------------------|
| Armon et al., 2008 [34] | 1,064 | Obesity | Waist-to-hip ratio: r = 0.02; Waist circumference: r = 0.02; Body Mass Index: r = 0.03 | - | Depressive symptomatology, physical exercise and age |
| Shirom et al., 2013 [74] | 3,337 | Hyperlipidemia | B = 0.04 Wald Test = 0.16 | - | Age, gender, obesity, education, smoking, financial strain, time lag T1-T2 (days) and physical exercise |
| Melamed et al., 2006 [65] | 677 | Type 2 Diabetes | - | OR = 1.84 (1.19–2.85)** | Age, sex, body mass index, smoking, alcohol use, leisure time physical activity, initial job category, and follow-up duration |
| Kitaoka-Higashiguchi et al., 2009 [59] | 383 | Risk factors for arteriosclerotic disease | Large waist circumference (WC > 85 cm) OR = 1.46 (0.49–4.38) High body mass index (BMI ≥ 25) OR = 1.97 (0.49–7.92) Metabolic syndrome OR = 1.17 (0.33–4.15) Hypertension (blood pressure ≥ 140/90 mmHg) OR = 0.67 (0.25–1.77) High triglycerides (triglycerides ≥ 150 mg/dl) OR = 1.19 (0.43–3.30) Low HDL cholesterol (HDL cholesterol < 40 mg/dl) OR = 0.83 (0.09–7.50) High LDL cholesterol (LDL cholesterol ≥ 140 mg/dl) OR = 1.34 (0.49–3.69) Impaired fasting glucose (fasting blood sugar ≥ 110 mg/dl) OR = 0.58 (0.12–2.71) | Hypercholesterolemia (total cholesterol ≥ 220 mg/dl) OR = 2.78 (1.20–6.46) | Age, alcohol consumption, smoking, and physical activity |
| Appels, Schouten, 1991 [32] | 3,210 | Coronary Heart Disease | - | Model 1: RR = 2.11 (1.28–3.48) ** Model 2: RR = 2.26 (1.37–3.72) ** Model 3: RR = 2.25 (1.37–3.69) ** Model 4: RR = 2.22 (1.35–3.66) ** Model 5: RR = 2.16 (1.31–3.55) ** | Model 1: age Model 2: cholesterol Model 3: systolic blood pressure Model 4: diastolic blood pressure Model 5: smoking |
| Toker et al., 2012 [77] | 8,838 | Coronary Heart Disease | - | Burnout Model 1: HR = 1.31 (1.03–1.66) ** Model 2: HR = 1.41 (1.08–1.85) ** High Burnout Model 1: HR = 1.70 (1.05–2.75) ** Model 2: HR = 1.79 (1.05–3.04) * | Model 1: age, sex, family history of CHD, cigarette smoking, education years, LDL, glucose, body mass index, systolic blood pressure, and exercise hours per week. Model 2: age, sex, smoking status, family history, depression and workload |
| Toppinen-Tanner et al., 2009 [80] | 7,897 | Hospitalization for cardiovascular and musculoskeletal disorders | Hospitalization for musculoskeletal disorders HR = 1.05 (0.98–1.13) | Hospitalization for cardiovascular disorders HR = 1.10 (1.02–1.19) | Hospitalization for cardiovascular disorders: age, sex, occupational status, physical environment, and use of medication for hypertension or diabetes. Hospitalization for musculoskeletal disorders: age, sex, occupational status, and physical environment at baseline |

(Continued)
Table 2. (Continued)

| AUTHORS, YEAR | N (FINAL SAMPLE) | DEPENDENT VARIABLE | MAIN FINDINGS | CONTROL VARIABLES |
|---------------|------------------|---------------------|---------------|--------------------|
| Armon et al., 2010 [36] | 1,068 | Musculoskeletal Pain | - | OR = 2.09 (1.07–4.10)* |
| Melamed, 2009 [66] | 650 | Musculoskeletal Pain | - | Burnout mean score OR = 1.67 (1.14–1.87)**; High burnout level OR = 2.45 (1.35–4.45) |
| Grossi et al., 2009 [48] | 2,300 | Changes in pain experiences | Headache Burnout at T1: OR = 0.99 (0.71–1.37) Burnout changes (T2-T1): OR = 1.34 (0.98–1.82) Pain intensity Burnout at T1: β = -0.08 Burnout changes (T2-T1): β = 0.01 Pain frequency Burnout at T1: β = 0.07 Burnout changes (T2-T1): β = 0.06 | Overall pain Burnout at T1: OR = 1.70 (1.34–2.16)** Burnout changes (T2-T1): OR = 1.63 (1.31–2.03)** Neck-shoulder pain Burnout at T1: OR = 1.64 (1.30–2.07)** Burnout changes (T2-T1): OR = 1.63 (1.31–2.04)** Back pain Burnout at T1: OR = 1.49 (1.19 = 1.87)** Burnout changes (T2-T1): OR = 1.49 (1.20–1.85)** Pain-related disability Burnout at T1: β = 0.23** Burnout changes (T2-T1): β = 0.19** | Sociodemographic (e.g., age, marriage, and education), work characteristics, smoking, psychological distress, physical health and basal pain parameters |
| Leone et al., 2009 [61] | 5,328 | Prolonged fatigue | - | HR = 1.33 (1.16–1.53) |
| Kim et al., 2011 [58] | 146 | Headaches, respiratory infections, and gastrointestinal problems | - | Headaches β = 0.23* Gastrointestinal problems β = 0.20* Respiratory infections β = 0.19* |
| Ahola et al., 2013 [31] | 10,062 | Severe Injuries (transport accidents, falls, other external causes of accidental injury, exposure to the forces of nature and accidental exposure to unspecified factors) | - | HR = 1.18 (1.02–1.36) |
| Ahola et al., 2010 [30] | 7,396 | Mortality | 45 years or older HR = 0.99 (0.84–1.17) | Below 45 years of age HR = 1.31 (1.04–1.66) |

*p<0.05  
**p<0.01  
HR = hazard ratio  
OR = odds ratio  
RR = risk ratio  
β = standardized partial regression coefficients  
B = unstandardized partial regression coefficients  
r = intercorrelations
Two studies confirmed a higher incidence of CHD among those exposed to burnout [32, 77]. A significant association between burnout and hospitalizations due to cardiovascular diseases has also been observed in a cohort study of industrial employees that lasted 10 years [80].

Musculoskeletal disorders have been shown to be significantly associated with burnout. Increased levels of burnout during 18 months of follow-up were associated with an increased risk of developing musculoskeletal pain [36]. Workers with high burnout levels had more than twice the risk of developing musculoskeletal pain compared to those without burnout [66]. Burnout was also a risk factor for hospitalizations due to musculoskeletal disorders after adjusting for age and gender; however, this association lost significance after further adjustments by occupational status and physical environment at baseline [80].

One study found a relationship between burnout and changes in pain experiences. Burnout at T1 (baseline) or changes in burnout levels between T1 and T2 were important predictors of overall pain, neck-shoulder pain, back pain, and pain-related disability. However, pain in the entire body, pain intensity and pain frequency were not associated after adjustments [48]. Headache was an outcome of burnout investigated in two studies [48, 58], but a significant association was found in only one study [58]. Both studies differed in the types of populations, measures of headache and control variables used in the analyses. The study that yielded a significant association was conducted among social workers in the US and measured headache through a general health questionnaire (PHQ) that contained 3 items related to headache (during the six previous months), resulting in scores ranging from 3 to 21; thus, headache was treated as a continuous variable. The analyses were adjusted for age, gender, field tenure and annual salary [58]. The other study investigated a random sample of Swedish women. Headache was assessed with a specific questionnaire on pain (several items) and was defined as pain during at least one month over the past three months; adjustments for the association between burnout and headache (incidence or increased ratings of intensity or frequency) were made for sociodemographic variables, work characteristics, smoking, psychological distress, physical health and basal pain parameters [48].

Some studies investigated burnout as a risk factor for prolonged fatigue [61], gastrointestinal issues, respiratory problems [58], severe injuries [31] and mortality below the age of 45 years [30]. All these consequences were significantly associated with burnout. However, burnout was not a significant predictor of mortality among those 45–65 years old [30].

### Psychological consequences

Insomnia and depressive symptoms were the main investigated psychological consequences (Table 3). Studies of 1,356 and 3,235 apparently healthy employees attending a center for a health examination showed burnout as a significant predictor of new cases of insomnia [33] and an increase in insomnia levels, respectively [35]. In these two studies [33, 35], insomnia was assessed using a slightly modified version of the AIS-5, which is a 5-item tool that evaluates difficulties with sleep induction and maintenance by self-reporting with a total score ranging from 5 to 35. In one study, new cases of insomnia were defined dichotomously (yes/no) [33], whereas in the other study [35], insomnia was treated as a continuous variable (changes in the level of the total score). However, a study of 1,258 workers randomly selected from the general working population in Sweden that analyzed the dimensions of burnout (emotional exhaustion, cynicism, and professional efficacy) separately did not find an association with the incidence (new cases of insomnia) or persistence of insomnia (from the baseline study until one year later) [55]. In this study, the authors defined insomnia as self-reported problems with sleep three or more times per week during the past three months and difficulty in initiating or maintaining sleep for 30 minutes or more per night [55]. Similarly, a study of 146 social
### Table 3. Main findings of longitudinal studies of psychological consequences of burnout.

| AUTHORS, YEAR | N (FINAL SAMPLE) | DEPENDENT VARIABLE | NOT SIGNIFICANT | MAIN FINDINGS | CONTROL VARIABLES |
|---------------|------------------|--------------------|-----------------|---------------|-------------------|
| Armon et al., 2008 [33] | 1,356 | Insomnia | - | OR = 1.93 (1.45–2.58) B = 0.06* β = 0.05* | Depressive symptomatology, body mass index, age and gender |
| Armon, 2009 [35] | 3,235 | Changes in levels of insomnia | - | T1 burnout predicted T2 insomnia (β = 0.06) | Insomnia (T1), depression, body mass index, age, gender and follow-up duration |
| Jansson-Fröjmark, Lindblom, 2010 [55] | 1,258 | Incidence and persistence of insomnia | Emotional exhaustion HR = 1.61 (0.80–3.26) Cynicism HR = 1.37 (0.73–2.56) Professional efficacy HR = 0.62 (0.28–1.41) | - | Age, gender, anxiety and depression |
| Kim et al., 2011 [58] | 146 | Sleep disturbances | Burnout was not associated with significant increases in sleep disturbances (β not shown) | - | Age, gender, field tenure and annual salary |
| Ahola, Hakanen, 2007 [27] | 2,555 | Depressive symptoms | - | OR = 2.6 (2.0–3.5) | Sex, age and marital status |
| Armon et al., 2014 [37] | 4,861 | Depressive symptoms | - | Burnout predicted an increase in depressive symptoms from T1 to T2 (β = 0.15**) | T1 depressive symptoms, T1 neuroticism, age, gender, education, marital status, number of children, financial strain, time between T1 and T2 and chronic medical illness |
| Toker, Biron, 2012 [78] | 1,632 | Depressive symptoms | - | An increase in job burnout from T1 to T2 predicted an increase in depression from T2 to T3 (β = 0.09**) | Education in T1, depression in T2, age, gender, the time gap between T1 and T3 and visits to the medical center |
| Bianchi et al., 2015 [38] | 627 | Depressive symptoms | After adjustment for depressive symptoms at T1, burnout at T1 no longer predicted depressive symptoms at T2 (β = 0.057, p>0.05). Burnout symptoms at T1 no longer predicted cases of major depression at T2 when depressive symptoms at T1 were included in the predictive model (OR = 1.319; 0.866–2.009) | - | Gender, age, length of employment and depressive symptoms at baseline |
| Madsen et al., 2015 [63] | 2,936 | Antidepressant treatment | - | Burnout was associated with an increased risk of antidepressant treatment, particularly among men. For high versus intermediate burnout levels, burnout predicted an increased risk of antidepressant treatment of 5.17% per year of follow-up for men and 0.96% per year of follow-up for women. | Age, cohabitation, occupational position and type of organization |
| Leiter et al., 2013 [60] | 4,356 | Psychotropic and antidepressant treatment | Antidepressants Efficacy: β = 0.009 Psychotropic medication Efficacy: β = 0.009 | Antidepressants Emotional exhaustion: β = 0.047** Cynicism: β = 0.041* Inconsistency (burnout dimensions): β = 0.051** Psychotropic medication Emotional exhaustion: β = 0.058** Cynicism: β = 0.038** Inconsistency (burnout dimensions): β = 0.054** | Age, sex and job characteristics |

(Continued)
workers in the USA found that burnout was not a predictor of sleep disturbances [58]. Sleep disturbances in this study were assessed using the Physical Health Questionnaire–PHQ, which is a 4-item tool encompassing self-reported difficulty in falling asleep, awakenings during the night, nightmares and perception of a peaceful or undisturbed night’s sleep.

Depressive symptoms were a psychological consequence that was investigated with different measurement tools, different numbers of participants and different follow-up times. Burnout was found to be a significant predictor of depressive symptoms among 2,555 dentists in a follow-up study lasting three years and a mediator between job strain and depressive symptoms [27]. In 18 months of follow-up, burnout also predicted an increase in depressive symptoms in a study of almost 5,000 apparently healthy workers attending a center for routine health examinations in Israel [37]. Additionally, in a three-wave study conducted between the years 2003 and 2009, an increase in job burnout from T1 to T2 was found to predict an increase in depressive symptoms from T2 to T3 in 1,632 Israeli workers attending the same health center, although this increase was attenuated by high physical activity levels [78]. However, burnout did not predict depressive symptoms in a study of 627 French school teachers that did not exclude those with depressive symptoms at baseline but controlled for this outcome in the follow-up analysis [38]. In all studies selected in our review, depressive symptoms were assessed with scales typically used in epidemiological studies to screen for possible clinical depression. An increased risk of antidepressant use, mainly among men, was also demonstrated by a study [63] that used records of the Danish national prescription registry, which contains data on all prescription medications purchased at pharmacies in Denmark. Men with high levels of burnout had an increase of 5.17% per year in the risk of entering antidepressant treatment compared to men with intermediate levels of burnout; this association was stronger for men than that observed for women (an increase of 0.96% per year). Similar results were found in a Finnish study that aimed to evaluate whether changes in burnout levels over a four-year period predicted the use of psychotropic and antidepressant medications in the following eight years. The authors noted that inconsistencies among the levels of the subdimensions of burnout at baseline, such as high emotional exhaustion and low cynicism or vice versa, as well as change toward burnout in four years, were predictors of psychotropic and antidepressant treatment [60].

Burnout was also a predictor of hospital admissions due to mental disorders over a 10-year period among Finnish forest industry employees [80]. Among employees from the financial

| AUTHORS, YEAR       | N (FINAL SAMPLE) | DEPENDENT VARIABLE                        | MAIN FINDINGS | CONTROL VARIABLES |
|---------------------|------------------|-------------------------------------------|---------------|-------------------|
| Toppinen-Tanner et al., 2009 [80] | 7,897            | Hospitalization for mental disorders      | Professional efficacy—HR = 1.03 (0.88–1.20) | Age and sex, occupational status, and physical environment |
| De Beer et al., 2016 [44] | 370              | Psychological ill-health symptoms         | -             | Age and gender    |

*p<0.05  
**p<0.01

HR = hazard ratios  
OR = odds ratio  
β = standardized partial regression coefficients  
B = unstandardized partial regression coefficients

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sector, burnout was a risk factor for psychological ill-health symptoms and a mediator between work overload and these symptoms [44].

**Occupational consequences**

Job satisfaction, absenteeism, new disability pension, job demands, job resources and presenteeism were the investigated outcomes (Table 4). Job dissatisfaction was an occupational consequence explored in two studies with relatively small samples (n ≤ 316). Emotional exhaustion was found to be a predictor of job dissatisfaction in both studies [47, 62], while depersonalization was found to be significantly associated in just one [47], which did not identify an association with professional efficacy.

Burnout was prospectively associated with sickness absence days and sickness absence spells. Workers with worse levels of burnout (those ranked in the highest quartile of the scale score) were absent from work, on average, 13.6 days per year, in comparison with those classified in the lowest quartile (5.4 days). An increase in the burnout score predicted increases of 21% and 9% in sickness absence days and sickness absence spells, respectively, even after adjustments for sociodemographic, work and health conditions [39]. An increase in absence duration (defined as the number of sick-leave days between T1 and T2) was an occupational consequence among workers with high levels of burnout [71].

The high and medium levels of burnout were associated with long-term sickness absence (>2 weeks) after adjustments for sociodemographic characteristics and health-related lifestyle. When psychosocial characteristics were added in the statistical model for adjustments, the effects of high and medium levels of work burnout were attenuated, although the results were still significant [40].

In a study that grouped the exhaustion and cynicism dimensions of burnout (ExCy), Hallsten et al. [51] observed a twofold risk of long-term sickness absence (>60 consecutive days) among those classified as high ExCy after adjustments. Burnout was also a predictor of both long-term sickness absence leaves (≥ 42 consecutive days) [68] and sick-leave absences (≥ 3 days) due to mental or behavioral problems [79]. Sick leaves due to musculoskeletal disorders of ≥ 3 days were a consequence of burnout [79], but no association was identified for long-term sickness absences due to these disorders (≥ 42 consecutive days) [68]. Additionally, burnout was a significant risk factor for sick-leave absences due to diseases of the circulatory and respiratory systems but not for diseases of the digestive system [79].

A study of 3,125 Finnish forest industry employees found that burnout significantly predicted new disability pensions during a 4-year follow-up period, even after adjustments for age, gender, marital status, occupational status, sector, mental disorders and physical illness. The same pattern of association was found, after all adjustments, for the burnout syndrome subdimensions of cynicism (in both genders) and emotional exhaustion (in men) [28]. These investigators, in a subsequent follow-up study [29] that lasted eight years and included 7,810 employees of the same forest industry, found that workers with severe burnout had a greater likelihood of receiving a new disability pension (15%) compared to those with mild (8%) or no burnout (5%). After adjustments for several confounders and chronic illness at baseline, severe burnout and severe emotional exhaustion significantly predicted a new disability pension. However, when analyzing causes of disabilities according to the presence of burnout and its subdimensions, only exhaustion significantly predicted new pensions for mental or other miscellaneous diseases, after all adjustments [29].

Job burnout prospectively affected the perception of job demands and job resources among Chinese workers [83]. A study of nurses revealed that both emotional exhaustion and
Table 4. Main findings of longitudinal studies of professional consequences of burnout.

| AUTHORS, YEAR | N (FINAL SAMPLE) | DEPENDENT VARIABLE | MAIN FINDINGS | CONTROL VARIABLES |
|---------------|------------------|--------------------|---------------|-------------------|
|               |                  |                    | NOT SIGNIFICANT | SIGNIFICANT       |                  |
| Figueiredo-Ferraz et al., 2012 [47] | 316 | Job satisfaction | Professional efficacy $\beta = 0.02$ | Emotional exhaustion $\beta = -0.15^{**}$ Depersonalization $\beta = -0.14^{**}$ | Age, sex, work contract and job satisfaction in T1 |
| Lizano, Barak, 2015 [62] | 133 | Job satisfaction | Depersonalization did not predict job satisfaction in low ($\beta = 0.04$) and high ($\beta = 0.08$) supervisory support groups | Higher levels of emotional exhaustion predicted lower levels of job satisfaction in both the low ($\beta = -0.46^{**}$) and high ($\beta = -0.48^{**}$) supervisory support groups | Age, race, tenure, position in the organization, role conflict, role ambiguity and work family |
| Borritz et al., 2006 [39] | 824 | Sickness absence days Sickness absence spells | - | Sickness absence days $RR = 1.21 (1.11–1.32)^{**}$ Sickness absence spells $RR = 1.09 (1.02–1.17)^{**}$ | Age, gender, organization status, socioeconomic status, BMI, smoking, alcohol consumption, leisure time physical activity, family status, having children below the age of 7, and diseases (diabetes, high blood pressure, chronic bronchitis, asthma, coronary thrombosis, cardiovascular spasm, cerebral hemorrhage, cerebral thrombosis, cancer, gastric ulcer, cystitis, menstruation-related pain, mental disorder, allergy, skin diseases, and backache) |
| Schaufeli et al., 2009 [71] | 201 | Absence duration | - | T1 burnout predicts T1–T2 absence duration ($\beta = 0.26$) | Age was not controlled for, but the authors reported that no significant correlations were observed between age and any of the study variables |
| Borritz et al., 2010 [40] | 1,734 | Long-term sickness absence (>2 weeks) | - | Highest level of work burnout Model 1: $RR = 2.93 (1.89–3.96)$ Model 2: $RR = 2.67 (1.79–3.55)$ Model 3: $RR = 2.67 (1.80–3.55)$ Model 4: $RR = 2.81 (1.89–3.72)$ Model 5: $RR = 2.72 (1.83–3.60)$ Model 6: $RR = 2.77 (1.87–3.67)$ Medium level of work burnout Model 1: $RR = 1.70 (1.11–2.29)$ Model 2: $RR = 1.57 (1.06–2.08)$ Model 3: $RR = 1.54 (1.05–2.04)$ Model 4: $RR = 1.58 (1.07–2.09)$ Model 5: $RR = 1.56 (1.06–2.07)$ Model 6: $RR = 1.57 (1.06–2.07)$ | Model 1: age, gender, socioeconomic status, family status, health-related lifestyle (smoking habits, alcohol consumption, sedentary lifestyle, overweight, underweight, and presence of chronic physical disease) Model 2: Model 1 plus emotional demands Model 3: Model 1 plus role conflicts Model 4: Model 1 plus role clarity Model 5: Model 1 plus predictability Model 6: Model 1 plus quality of leadership |
| Hallsten et al., 2011 [51] | 4,109 | Long-term sickness absence (>60 consecutive days) | - | $OR = 2.05 (1.13–3.70)$ | Gender, age group, level of occupational skill, family status, chronic disorders, daily smoking and previous sickness absence |
| Roelen et al., 2015 [68] | 4,894 | Long-term sickness absence (≥42 consecutive days) | Musculoskeletal long-term sickness absence $OR = 1.38 (0.74–2.58)$ | Mental long-term sickness absence $OR = 1.55 (1.07–2.25)^{*}$ | Age, gender, marital status, children at home, employment, work hours/week, tenure in work, BMI, physical activity, smoking habits, alcohol consumption and the use of drugs and sedatives |

(Continued)
Depersonalization had effects on future perception of high job demands and that emotional exhaustion predicted presenteeism [45].

The investigated and statistically significant consequences of burnout are shown in Fig 3.

**Discussion**

To the best of our knowledge, this is the first comprehensive systematic review of the prospective effects of job burnout. This review provides relevant evidence of the physical, psychological and occupational consequences of this syndrome to workers. No limits were defined for the literature search, such as language or time of publication. Selection and methodological evaluation of the articles were performed independently by two authors and followed PRISMA guidelines [12]. To guarantee a higher quality of evidence, we defined minimal criteria that should be followed when prospective studies are conducted in order to avoid selection bias or
other types of bias [13, 19, 23–26]. Nevertheless, a meta-analysis could not be performed due to the heterogeneity of the studies, mainly regarding measures of burnout or outcomes that were analyzed in more than one study (e.g., depressive symptoms or absenteeism). Therefore, we were not able to assess publication bias with statistical procedures, because the results of the included articles could not be analyzed using meta-analysis methods. We cannot rule out the possibility that some of the excluded studies are also of high methodological quality but were not included because they did not report exclusion of the outcome at baseline or they failed to report adjustments. Finally, studies with students were not included in our review, although undergraduate and graduate medical students in particular may experience many of the stressors and consequences of professional burnout [88]. We found only one study that longitudinally analyzed burnout as a potential risk factor for ill health among medical students; burnout (depersonalization and a low sense of personal accomplishment) was a predictor of suicidal intention over the following one year, whereas recovery from burnout reduced the risk of this outcome [88]. This serious and life-threatening outcome may also occur in working populations experiencing burnout.

The majority of the cohort studies selected for this review was from Nordic countries. This may be due to the availability of reliable registries on health and social benefits in these countries [8, 28–31, 40, 63, 68], which make it possible to identify employees, link records and therefore conduct studies of large sample sizes. It is important to note that the political and
economic situation in these countries favors better work and health conditions. Therefore, there is still room for research in low- and middle-income countries, where work conditions and access to healthcare are less favorable. In such regions, for instance, workers may not have the option of choosing their job or may not be able to quit their job for survival reasons. In addition, low- and middle-income countries generally do not have well-structured health services or state-of-the-art technologies, and the quality of assistance may be less than optimal, all of which can affect the health of the population.

Among the physical consequences of burnout that were prospectively investigated, cardiovascular diseases and pain stood out. Cardiovascular diseases were also more frequently reported as causes of absenteeism by workers with burnout in a study classified under occupational consequences. As burnout follows a state of chronic stress, it has been suggested that the biological mechanisms resulting from prolonged stress may deteriorate physical health. One hypothesis is that the autonomic nervous system (ANS) and the hypothalamic-pituitary-adrenal (HPA) axis become exhausted due to burnout. This results in overactivation of vital functions (e.g., heart rate and blood pressure) and damage to metabolism and the immune system [89]. According to Melamed et al. [90], potential mechanisms linking burnout to cardiovascular diseases include its associations with components of metabolic syndrome, dysregulation of the HPA axis, inflammation, sleep disorders, reduced immunity, changes in blood coagulation, changes in fibrinolysis, and adoption of poor health behaviors, such as smoking and lack of physical activity. In fact, cumulative work stress has been shown to be associated with the incidence of cardiovascular events, and this relationship was mediated by both the direct effects of neuroendocrine mechanisms and the indirect effects of unhealthy behaviors, particularly poor diet and low physical activity [91].

Impaired immune function in individuals with burnout may increase their susceptibility to infectious diseases such as flu-like illnesses, the common cold and gastroenteritis [67], which is in line with the results observed for respiratory infections and gastroenteritis in one study included in this review [58]. In addition, burnout was a predictor of musculoskeletal pain, although the pathophysiological pathways linking these conditions remain unclear [66]. The findings regarding the longitudinal relationship between burnout and headaches were not consistent, one study detected a significant association [58], whereas the other study did not [48]. This divergence may be due to the different methodologies used and may be mainly related to the previous timeframe in which headache was investigated (six months vs three months) and the definition of headache used, among other factors. Moreover, the type of headache was not investigated (tension headache, acute or chronic headache, migraine) in either study. In epidemiological studies, the case definition of headache can be problematic [92], particularly tension-type headaches, which are the most common type. This issue may result in different rates of incidence or prevalence [92] and can impact on the investigated associations. However, there is evidence that psychological stress, which is closely related to burnout and pain, is a contributing factor to headache [93], and several mechanisms linking stress to headache have been proposed, such as sympathetic hyperactivity [94]. Workers under recurrent or prolonged stress may also more frequently engage in unhealthy behaviors, such as a poor or rich diet, a lack of physical exercise and alcohol abuse. When combined with sleep disorders, these unhealthy behaviors may lead to a myriad of other consequences [35, 59], such as obesity [8] and diabetes [65].

Burnout significantly predicted depressive symptoms or antidepressant treatment in the majority of the studies that investigated psychological consequences, and these relationships were stronger for the subdimensions emotional exhaustion and depersonalization. Some authors have recently renewed debate on the overlap between burnout and depression, as they found that these conditions were highly correlated with each other, therefore advocating that
burnout should be considered a depressive syndrome [95]. However, Maslach and Leiter [4] have argued that there are problems with this analysis since the instruments used for measuring burnout and depression are both dominated by fatigue. They concluded that it is not surprising that they would overlap. Moreover, studies on the discriminant validity of burnout and depression [96, 97] have demonstrated that these conditions are distinct constructs. In the present review, studies that detected associations between burnout and depressive symptoms either excluded those affected by this outcome at baseline or controlled for these symptoms, which favors the argument that these are indeed distinct conditions.

The results regarding the incidence of sleep problems following burnout were not consistent in our review. Insomnia or changes in insomnia levels were found to be consequences of burnout in two studies with apparently healthy employees attending a center for periodic health examinations in Israel [33, 35] but not in a study with a random sample of employed individuals taken from the general population of the Örebro County, Sweden [55]. Another study with social workers in the state of California, USA, also did not find that burnout was a risk factor for sleep disturbances, although the final sample of this study was relatively small (n = 146) [58]. These differences may be due to the varying methodologies of the studies, with different tools used to measure burnout or sleep disturbances. Moreover, the studies with Israeli workers excluded people with cardiovascular diseases, diabetes, those who had suffered a stroke or a mental crisis and those taking antidepressants or antipsychotic medication [33, 35], which are conditions usually related to burnout or sleep problems and thus increased internal validity. Conversely, the Swedish study included employees regardless of their health statuses, perhaps thereby increasing external validity, although reducing internal validity [55]. More longitudinal studies with both internal and external validity are needed to explore the incidence of sleep problems among burned out workers. Measuring sleep disturbances with objective measures, such as actigraphy or polysomnography, is also important [98].

Burnout can also trigger presenteeism [45] and absenteeism [39, 40, 51, 68, 79]. While absenteeism means absence from work, presenteeism represents a phenomenon when people come to work even when sick, leading to a loss of productivity. In a vicious circle, as a consequence of health problems caused by burnout, workers may not reach the desirable performance at work, which in turn may lead to increasing levels of emotional exhaustion [86, 99]. The worker’s weakened health along with his/her diminished functional capacity may lead to absenteeism, a great cause of concern for the worker and the organizations that has both social and economic consequences. For the individual, absenteeism or presenteeism due to health problems may represent the beginning of a process of social decline involving job loss and even permanent exclusion from the labor market. For organizations, absenteeism means a loss of manpower, additional expenses associated with temporary workers and a decrease in productivity [39]. In this review, we observed that workers who experienced medium or high levels of burnout were at higher risk of short or long-term sickness absences. In addition to absenteeism, there is evidence that burnout also increased the risk of future disability pension [28, 29].

In our review, we focused on the longitudinal relationships between burnout and physical, psychological and occupational outcomes and we highlighted some of the complex mechanisms involved in this process. Some of these mechanisms have been investigated in several studies on the antecedents and outcomes of burnout, most of which have adopted the theoretical framework of the job demands-resources (JD-R) model [100]. This model posits that work demands (e.g., high workload and time pressure) leads to negative outcomes via burnout (stress process), whereas work resources (e.g., autonomy and peers’ support) via work engagement contribute to positive outcomes (motivational process) [101, 102]. Studies have shown that burnout is more stable than engagement over time [103, 104]. More recently, leadership
was integrated into the JD-R model to examine its relationships with a variety of demands, resources and outcomes. The authors found that leadership had a direct effect on the investigated outcomes (employability, performance, commitment and performance behavior) and an indirect effect on burnout and engagement by reducing demands and increasing job resources [102]. Reports have suggested that both the level of demands and the types of demands (challenge or hindrance) can impact the work-related well-being of employees, as revealed in a study in which job resources (support from colleagues, performance feedback, supervisor coaching and opportunities for development) fostered workers’ well-being (positive affectivity and work engagement) specifically under high-challenge demand conditions but not under hindrance demands [105]. There is also an ongoing debate about the concept of engagement regarding its relationship with burnout (i.e., if engagement is the opposite of burnout or if they are distinct constructs) [4, 106]. In a recent meta-analytic study, Goering et al. [106] showed that burnout and engagement seemed to be distinct constructs when antecedents (resources, challenge demands and hindrance demands) were analyzed; however, the pattern was less clear for consequences (performance, turnover intention, job satisfaction, organization commitment and indicators of physical health). Burnout and engagement seem to act as opposites for turnover intention and task performance; however, due to the large heterogeneity of effect sizes in the population with distributions ranging from positive to negative values, the authors concluded that several boundary conditions (moderators) might exist, many of which probably had not been investigated to date. These aforementioned aspects in connection with the results of our review suggest the need to more deeply investigate the process leading from burnout to health or occupational outcomes, especially by incorporating factors that may confound the relationship and analyzing the role of possible mediators that can change the pattern of associations (e.g., moderating the relationships). As shown in our review, the majority of studies had only two waves. Considering the dynamics and the complexity of the relationship between variables, knowledge could be extended by studies with multiple waves to try to capture changes in work conditions, burnout, engagement and the incidence of diverse outcomes [27, 44, 49].

In summary, the present systematic review based on well-conducted and well-reported studies shows that cardiovascular diseases, musculoskeletal pain, depressive symptoms, psychotropic and antidepressant treatment, job dissatisfaction and absenteeism are consistent effects of burnout. Conflicting findings were observed for headache and insomnia. Other consequences were found in only one study; therefore, there is still a need to investigate these relationships with burnout in longitudinal studies. The individual and social impacts of burnout highlight the need for preventive interventions and early identification of this health condition in the work environment.

Supporting information
S1 Appendix. Prisma checklist.
(DOC)

S2 Appendix. Search strategy.
(DOCX)

S3 Appendix. Assessment of quality in cohort studies about burnout consequences.
(DOCX)

S4 Appendix. Characteristics of the 25 articles not included in this systematic review.
(DOCX)
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References

1. Seidler A, Thinschmidt M, Deckert S, Then F, Hegewald J, Nieuwenhuijsen K, et al. The role of psychosocial working conditions on burnout and its core component emotional exhaustion-a systematic review. J Occup Med Toxicol. 2014; 9(1):10. https://doi.org/10.1186/1745-6673-9-10 PMID: 24628839

2. Maslach C, Jackson SE. The measurement of experienced burnout. J Organ Behav. 1981; 2(2):99–113. https://doi.org/10.1002/job.4090020205

3. Maslach C, Schaufeli WB, Leiter MP. Job burnout. Annu Rev Psychol. 2001; 52(1):397–422. https://doi.org/10.1146/annurev.psych.52.1.397 PMID: 11148311

4. Maslach C, Leiter MP. Understanding the burnout experience: recent research and its implications for psychiatry. World Psychiatry. 2016; 15(2):103–11. https://doi.org/10.1002/wps.20311 PMID: 27265691.

5. Ahola K, Honkonen T, Pirkola S, Isometsä E, Kalimo R, Nykyri E, et al. Alcohol dependence in relation to burnout among the Finnish working population. Addiction. 2006; 101(10):1438–43. https://doi.org/10.1111/j.1360-0443.2006.01539.x PMID: 16968345

6. Brand S, Beck J, Hatzinger M, Harbaugh A, Ruch W, Holsboer-Trachsel E. Associations between satisfaction with life, burnout-related emotional and physical exhaustion, and sleep complaints. World J Biol Psychiatry. 2010; 11(5):744–54. https://doi.org/10.3109/15622971003624205 PMID: 20331383
7. Ahola K, Honkonen T, Isometsä E, Kalimo R, Nykyri E, Aromaa A, et al. The relationship between job-related burnout and depressive disorders—results from the Finnish Health 2000 Study. J Affect Disord. 2005; 88(1):55–62. https://doi.org/10.1016/j.jad.2005.06.004 PMID: 16038984

8. Ahola K, Pulikki-Räablo L, Kouvonen A, Rossi H, Aromaa A, Lönnqvist J. Burnout and behavior-related health risk factors: results from the population-based Finnish Health 2000 study. J Occup Environ Med. 2012; 54(1):17–22. https://doi.org/10.1097/JOM.0b013e31823ea8d9 PMID: 22157806

9. Ahilinejad M, Zargham Sadeghi AA, Sarebanha S, Bahrami-Ahmadi A. Role of occupational stress and burnout in prevalence of musculoskeletal disorders among embassy personnel of foreign countries in Iran. Iran Red Crescent Med J. 2014; 16(5):e9066. https://doi.org/10.5812/ircmj.9066 PMID: 25031868

10. Lee J, Lim N, Yang E, Lee SM. Antecedents and consequences of three dimensions of burnout in psychotherapists: A meta-analysis. Prof Psychol Res Pr. 2011; 42(3):252–8.

11. Khamisa N, Peltzer K, Oldenburg B. Burnout in relation to specific contributing factors and health outcomes among nurses: a systematic review. Int J Environ Res Public Health. 2013; 10(6):2214–40. https://doi.org/10.3390/ijerph10062214 PMID: 23727902

12. Moher D, Shamseer L, Clarke M, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev. 2015; 4(1):1. https://doi.org/10.1186/2046-4053-4-1 PMID: 25554246

13. Sanderson S, Tatt ID, Higgins JP. Tools for assessing quality and susceptibility to bias in observational studies in epidemiology: a systematic review and annotated bibliography. Int J Epidemiol. 2007; 36(3):666–76. https://doi.org/10.1093/ije/dym018 PMID: 17470488

14. Jarde A, Losilla J-M, Vives J. Methodological quality assessment tools of non-experimental studies: a systematic review. Ann Psych. 2012; 28(2):617–28. Epub 2012-05-01. https://doi.org/10.6018/analesps.28.2.148911

15. Shamliyan T, Kane RL, Dickinson S. A systematic review of tools used to assess the quality of observational studies that examine incidence or prevalence and risk factors for diseases. J Clin Epidemiol. 2010; 63(10):1061–70. https://doi.org/10.1016/j.jclinepi.2010.04.014. PMID: 20728045

16. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. Eur J Epidemiol. 2010; 25(9):603–5. https://doi.org/10.1007/s10654-010-9491-z PMID: 20652370.

17. Lo CK, Mertz D, Loeb M. Newcastle-Ottawa Scale: comparing reviewers’ to authors’ assessments. BMC Med Res Methodol. 2014; 14:45. https://doi.org/10.1186/1471-2288-14-45 PMID: 24690082.

18. Hartling L, Milne A, Hamm MP, Vandermeer B, Ansari M, Tsertsvadze A, et al. Testing the Newcastle Ottawa Scale showed low reliability between individual reviewers. J Clin Epidemiol. 2013; 66(9):982–93. https://doi.org/10.1016/j.jclinepi.2013.09.003 PMID: 23683848.

19. Whiting P, Rutjes AW, Reitsma JB, Bossuyt PM, Kleijnen J. The development of QUADAS: a tool for the quality assessment of studies of diagnostic accuracy included in systematic reviews. BMC Med Res Methodol. 2003; 3:25. https://doi.org/10.1186/1471-2288-3-25 PMID: 14606960.

20. Jarde A, Losilla J-M, Vives J, Rodrigo MF. Q-Coh: A tool to screen the methodological quality of cohort studies in systematic reviews and meta-analyses. Int J Clin Health Psychol. 2013; 13(2):138–46. http://dx.doi.org/10.1016/S1697-2600(13)70017-6.

21. Wells G, Shea B, Connell DO, Peterson J, Welch V, Losos M, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses: Ottawa Hospital Research Institute; 2014 [cited 2016 Jan 5]. Available from: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp.

22. The Joanna Briggs Institute. Checklist for Cohort Studies Adelaide: The Joanna Briggs Institute, University of Adelaide; 2016 [cited 2016 Feb 28]. Available from: http://joannabriggs.org/research/critical-appraisal-tools.html.

23. von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008; 61(4):344–9. https://doi.org/10.1016/j.jclinepi.2007.11.008 PMID: 18313558.

24. Szklo M, Javier Neto F. Epidemiology: beyond the basics. 2nd ed. London: Jones and Bartlett Publishers International; 2007.

25. Gordis L. Epidemiology. 4th ed. Philadelphia, PA: Saunders Elsevier; 2009.

26. Chatfield MD, Brayne CE, Matthews FE. A systematic literature review of attrition between waves in longitudinal studies in the elderly shows a consistent pattern of dropout between differing studies. J Clin Epidemiol. 2005; 58(1):13–9. https://doi.org/10.1016/j.jclinepi.2004.05.006 PMID: 15649666.
27. Ahola K, Hakanen J. Job strain, burnout, and depressive symptoms: A prospective study among dentists. J Affect Disord. 2007; 104(1):103–10. https://doi.org/10.1016/j.jad.2007.03.004 PMID: 17448543

28. Ahola K, Gould R, Virtanen M, Honkonen T, Aromaa A, Lönnqvist J. Occupational burnout as a predictor of disability pension: a population-based cohort study. Occup Environ Med. 2009; 66(5):284–90. https://doi.org/10.1136/oem.2008.038935 PMID: 19017706

29. Ahola K, Toppinen-Tanner S, Huhtanen P, Koskinen A, Väänänen A. Occupational burnout and chronic work disability: An eight-year cohort study on pensioning among Finnish forest industry workers. J Affect Disord. 2009; 115(1):150–9. https://doi.org/10.1016/j.jad.2008.09.021 PMID: 18945493

30. Ahola K, Väänänen A, Koskinen A, Kouvonen A, Shirom A. Burnout as a predictor of all-cause mortality among industrial employees: a 10-year prospective register-linkage study. J Psychosom Res. 2010; 69(1):51–7. https://doi.org/10.1016/j.jpsychores.2010.01.002 PMID: 20630263

31. Ahola K, Salminen S, Toppinen-Tanner S, Koskinen A, Väänänen A. Occupational burnout and severe injuries: An eight-year prospective cohort study among Finnish forest industry workers. J Occup Health. 2013; 55(6):450–7. PMID: 24162145

32. Appels A, Schouten E. Burnout as a risk factor for coronary heart disease. Behav Med. 1991; 17(2):53–9. https://doi.org/10.1080/08964289.1991.9935158 PMID: 1878609

33. Armon G, Shirom A, Shapira I, Melamed S. On the nature of burnout–insomnia relationships: A prospective study of employed adults. J Psychosom Res. 2008; 65(1):5–12. https://doi.org/10.1016/j.jpsychores.2008.01.012 PMID: 18582606

34. Armon G, Shirom A, Berliner S, Shapira I, Melamed S. A prospective study of the association between obesity and burnout among apparently healthy men and women. J Occup Health Psychol. 2008; 13(1):43–57. https://doi.org/10.1037/1076-8998.13.1.43 PMID: 18211168

35. Armon G. Do burnout and insomnia predict each other’s levels of change over time independently of the job demand control–support (JDC–S) model? Stress Health. 2009; 25(4):333–42. https://doi.org/10.1002/smi.1266

36. Armon G, Melamed S, Shirom A, Shapira I. Elevated burnout predicts the onset of musculoskeletal pain among apparently healthy employees. J Occup Health Psychol. 2010; 15(4):399–408. https://doi.org/10.1037/a0020726 PMID: 21058854

37. Armon G, Melamed S, Toker S, Berliner S, Shapira I. Joint effect of chronic medical illness and burnout on depressive symptoms among employed adults. Health Psychol. 2014; 33(3):264–72. https://doi.org/10.1037/a003712 PMID: 23895204

38. Bianchi R, Schonfeld IS, Laurent E. Burnout does not help predict depression among French school teachers. Scand J Work Environ Health. 2015; 41(6):565–8. https://doi.org/10.5271/sjweh.3522 PMID: 26343843.

39. Borritz M, Rugulies R, Christensen K, Villadsen E, Kristensen T. Burnout as a predictor of self-reported sickness absence among human service workers: prospective findings from three year follow up of the PUMA study. Occup Environ Med. 2006; 63(2):98–106. https://doi.org/10.1136/oem.2004.019364 PMID: 16421387

40. Borritz M, Christensen KB, Bøltmann U, Rugulies R, Lund T, Andersen I, et al. Impact of burnout and psychosocial work characteristics on future long-term sickness absence. Prospective results of the Danish PUMA Study among human service workers. J Occup Environ Med. 2010; 52(10):964–70. https://doi.org/10.1097/JOM.0b013e3181f12f95 PMID: 20881631

41. Burke RJ, Greenglass E. A longitudinal study of psychological burnout in teachers. Hum Relat. 1995; 48(2):187–202.

42. Burke RJ, Greenglass ER, Schwarzer R. Predicting teacher burnout over time: Effects of work stress, social support, and self-doubts on burnout and its consequences. Anxiety Stress Coping. 1996; 9(3):261–75. https://doi.org/10.1080/10615809608249406

43. De Beer LT, Pienaar J, Rothmann S Jr. Investigating the reversed causality of engagement and burnout in job demands-resources theory. SA J Ind Psychol. 2013; 39(1):01–9.

44. De Beer LT, Pienaar J, Rothmann S Jr. Work overload, burnout, and psychological ill-health symptoms: a three-wave mediation model of the employee health impairment process. Anxiety Stress Coping. 2016; 29(4):387–99. https://doi.org/10.1080/10615806.2015.1061123 PMID: 26079200.

45. Demerouti E, Le Blanc PM, Bakker AB, Schaufeli WB, Hoel J. Present but sick: a three-wave study on job demands, presenteeism and burnout. Career Dev Int. 2009; 14(1):50–68.

46. Dubois CA, Bentein K, Mansour JB, Gilbert F, Bedard JL. Why some employees adopt or resist reorganization of work practices in health care: associations between perceived loss of resources, burnout, and attitudes to change. Int J Environ Res Public Health. 2014; 11(1):187–201. https://doi.org/10.3390/ijerph110100187 PMID: 24362547.
47. Figueiredo-Ferraz H, Grau-Alberola E, Gil-Monte PR, Garcia-Juesas JA. [Burnout and job satisfaction among nursing professionals]. Psicothema. 2012; 24(2):271–6. PMID: 22420356.

48. Grossi G, Thomten J, Fandiño-Losada A, Soares JJ, Sundin Ö. Does burnout predict changes in pain experiences among women living in Sweden? A longitudinal study. Stress Health. 2009; 25(4):297–311.

49. Hakanen JJ, Schaufeli WB, Ahola K. The Job Demands-Resources model: A three-year cross-lagged study of burnout, depression, commitment, and work engagement. Work Stress. 2008; 22(3):224–41. https://doi.org/10.1080/02678370802379432

50. Hakanen JJ, Schaufeli WB. Do burnout and work engagement predict depressive symptoms and life satisfaction? A three-wave seven-year prospective study. J Affect Disord. 2012; 141(2-3):415–24. https://doi.org/10.1016/j.jad.2012.02.043 PMID: 22445702.

51. Hallsten L, Voss M, Stark S, Josephson M. Job burnout and job wornout as risk factors for long-term sickness absence. Work. 2011; 38(2):181–92. https://doi.org/10.3233/WOR-2011-1120 PMID: 21297288.

52. Huang J, Wang Y, Wu G, You X. Crossover of burnout from leaders to followers: a longitudinal study. Eur J Work Organ Psy. 2016; 25(6):849–61. https://doi.org/10.1080/1359432X.2016.1167682

53. Idries MA, Dollard MF, Yulita. Psychosocial safety climate, emotional demands, burnout, and depression: a longitudinal multilevel study in the Malaysian private sector. J Occup Health Psychol. 2014; 19(3):291–302. Epub 2014/05/08. https://doi.org/10.1037/a0036599 PMID: 24802994.

54. Innstrand ST, Langballe EM, Espnes GA, Falkum E, Gjerlow Aasland O. Positive and negative work-family interaction and burnout: A longitudinal study of reciprocal relations. Work Stress. 2008; 22(1):1–15.

55. Jansson-Frojmark M, Lindblom K. Is there a bidirectional link between insomnia and burnout? A prospective study in the Swedish workforce. Int J Behav Med. 2010; 17(4):306–13. https://doi.org/10.1007/s12129-010-9107-8 PMID: 20589489.

56. Kadzielski JJ, Bot AG, Ring D. The influence of job satisfaction, burnout, pain, and worker’s compensation status on disability after finger injuries. J Hand Surg Am. 2012; 37(9):1812–9. https://doi.org/10.1016/j.jhsa.2012.05.023 PMID: 22763059.

57. Khamisa N, Peltzer K, Ilic D, Oldenburg B. Work related stress, burnout, job satisfaction and general health of nurses: A follow-up study. Int J Nurs Pract. 2011; 17(4):306–13. https://doi.org/10.3233/WOR-2011-1120 PMID: 21297288.

58. Kim H, Ji J, Kao D. Burnout and physical health among social workers: A three-year longitudinal study. Soc Work. 2011; 56(3):258–68. PMID: 21848090.

59. Kitaoka-Higashiguchi K, Morikawa Y, Miura K, Sakurai M, Ishizaki M, Kido T, et al. Burnout and risk factors for arteriosclerotic disease: follow-up study. J Occup Health. 2009; 51(2):123–31. PMID: 19212087.

60. Leiter MP, Hakanen JJ, Ahola K, Toppinen-Tanner S, Koskinen A, Väänänen A. Organizational predictors and health consequences of changes in burnout: A 12-year cohort study. J Organ Behav. 2013; 34(7):959–73.

61. Leone SS, Huibers MJ, Knottenbus JA, Kant I. The temporal relationship between burnout and prolonged fatigue: a 4-year prospective cohort study. Stress Health. 2009; 25(4):365–74.

62. Lizano EL, Barak MM. Job burnout and affective wellbeing: A longitudinal study of burnout and job satisfaction among public child welfare workers. Child Youth Serv Rev. 2015; 55(2015):18–28.

63. Madsen IE, Lange T, Borritz M, Rugulies R. Burnout as a risk factor for antidepressant treatment—a repeated measures time-to-event analysis of 2936 Danish human service workers. J Psychiatr Res. 2015; 65:47–52. https://doi.org/10.1016/j.jpsychires.2015.04.004 PMID: 25943951.

64. McManus IC, Winder BC, Gordon D. The causal links between stress and burnout in a longitudinal study of UK doctors. Lancet. 2002; 359(9323):2089–90. PMID: 12086767.

65. Melamed S, Shiroam A, Toker S, Shapiro I. Burnout and risk of type 2 diabetes: a prospective study of apparently healthy employed persons. Psychosom Med. 2006; 68(6):863–9. https://doi.org/10.1097/01.psy.0000242860.24009.fo PMID: 17132837.

66. Melamed S. Burnout and risk of regional musculoskeletal pain—a prospective study of apparently healthy employed adults. Stress Health. 2009; 25(4):313–21.

67. Mohren DC, Swaen GM, Kant IJ, van Amelsvoort LG, Borm PJ, Galama JM. Common infections and the role of burnout in a Dutch working population. J Psychosom Res. 2003; 55(3):201–8. PMID: 12932792.

68. Roelen CA, van Hofsen MF, Groothoff JW, de Bruin J, Schaufeli WB, van Rhenen W. Can the Maslach Burnout Inventory and Utrecht Work Engagement Scale be used to screen for risk of long-term...
69. Rudman A, Gustavsson JP. Early-career burnout among new graduate nurses: a prospective observational study of intra-individual change trajectories. Int J Nurs Stud. 2011; 48(3):292–306. https://doi.org/10.1016/j.ijnurstu.2010.07.012 PMID: 20696427.

70. Rudman A, Gustavsson JP. Burnout during nursing education predicts lower occupational preparedness and future clinical performance: a longitudinal study. Int J Nurs Stud. 2012; 49(8):988–1001. https://doi.org/10.1016/j.ijnurstu.2012.03.010 PMID: 22542085.

71. Schaufeli WB, Bakker AB, Van Rhenen W. How changes in job demands and resources predict burnout, work engagement, and sickness absenteeism. J Organ Behav. 2009; 30(7):893–917. https://doi.org/10.1002/job.595

72. Shin H, Noh H, Jang Y, Park YM, Lee SM. A longitudinal examination of the relationship between teacher burnout and depression. J Empy Couns. 2013; 50(3):124–37.

73. Shirom A, Westman M, Shamai O, Carel RS. Effects of work overload and burnout on cholesterol and triglycerides levels: the moderating effects of emotional reactivity among male and female employees. J Occup Health Psychol. 1997; 2(4):275–88. PMID: 9552297.

74. Shirom A, Toker S, Melamed S, Berliner S, Shapira I. Burnout and vigorousness as predictors of the incidence of hyperlipidemia among healthy employees. Apnl Psychol Health Well Being. 2013; 5(1):79–98. https://doi.org/10.1111/j.1758-0854.2012.01071.x PMID: 23457085.

75. Shoji K, Lesnierowska M, Smoktunowicz E, Bock J, Luszczynska A, Benight CC, et al. What Comes First, Job Burnout or Secondary Traumatic Stress? Findings from Two Longitudinal Studies from the U.S. and Poland. PLoS One. 2015; 10(8):e0136730. https://doi.org/10.1371/journal.pone.0136730 PMID: 26305222.

76. Tang CSK, Au WT, Schwarzer R, Schmitz G. Mental health outcomes of job stress among Chinese teachers: Role of stress resource factors and burnout. J Organ Behav. 2001; 22(8):887–901.

77. Toker S, Melamed S, Berliner S, Zeltser D, Shapira I. Burnout and risk of coronary heart disease: a prospective study of 8838 employees. Psychosom Med. 2012; 74(8):840–7. https://doi.org/10.1097/PSY.0b013e31826c3174 PMID: 23006431.

78. Toker S, Biron M. Job burnout and depression: unraveling their temporal relationship and considering the role of physical activity. J Appl Psychol. 2012; 97(3):699–710. https://doi.org/10.1037/a0026914 PMID: 22229693.

79. Toppinen-Tanner S, Ahola K, Koskinen A, Vaänänen A. Burnout predicts hospitalization for mental and cardiovascular disorders: 10-year prospective results from industrial sector. Stress Health. 2009; 25(4):287–96.

80. Travis DJ, Lizano EL, Mor Barak ME. 'I'm So Stressed!': A Longitudinal Model of Stress, Burnout and Engagement among Social Workers in Child Welfare Settings. Br J Soc Work. 2016; 46(4):1076–95. https://doi.org/10.1093/bjsw/bct205 PMID: 27559215.

81. Vinokur AD, Pierce PF, Lewandowski-Romps L. Disentangling the relationships between job burnout and perceived health in a military sample. Stress Health. 2009; 25(4):355–63.

82. Wang Y, Huang J, You X. Personal resources influence job demands, resources, and burnout: a one-year, three-wave longitudinal study. Soc Behav Personal. 2016; 44(2):247–58.

83. Wolpin J, Burke RJ, Greenglass ER. Is job satisfaction an antecedent or a consequence of psychological burnout? Hum Relat. 1991; 44(2):193–209.

84. Wright TA, Bonett DG. The contribution of burnout to work performance. J Organ Behav. 1997; 18(5):491–9.

85. Wright TA, Cropanzano R. Emotional exhaustion as a predictor of job performance and voluntary turnover. J Appl Psychol. 1998; 83(3):486–93. PMID: 9648526.

86. Ybema JF, Smulders PG, Bongers PM. Antecedents and consequences of employee absenteeism: A longitudinal perspective on the role of job satisfaction and burnout. Eur J Work Organ Psych. 2010; 19(1):102–24.

87. Dyrbye LN, Thomas MR, Massie FS, Power DV, Eacker A, Harper W, et al. Burnout and suicidal ideation among U.S. medical students. Annals of internal medicine. 2008; 149(5):334–41. Epub 2008/09/04. PMID: 18765703.

88. Danhof-Pont MB, van Veen T, Zitman FG. Biomarkers in burnout: a systematic review. J Psychosom Res. 2011; 70(6):505–24. https://doi.org/10.1016/j.jpsychores.2010.10.012 PMID: 21624574.
90. Melamed S, Shiro A, Toker S, Berlin S, Shapiro I. Burnout and risk of cardiovascular disease: evidence, possible causal paths, and promising research directions. Psychol Bull. 2006; 132(3):327–53. https://doi.org/10.1037/0033-2909.132.3.327 PMID: 16719565.

91. Chandola T, Britton A, Brunner E, Hemingway H, Malik M, Kumari M, et al. Work stress and coronary heart disease: what are the mechanisms? Eur Heart J. 2008; 29(5):640–8. https://doi.org/10.1093/eurheartj/ehm584 PMID: 18216031.

92. Jensen R, Stovner LJ. Epidemiology and comorbidity of headache. The Lancet Neurology. 2008; 7(4):354–61. Epub 2008/03/15. https://doi.org/10.1016/S1474-4422(08)70062-0 PMID: 18339350.

93. Pellegrino ABW, Davis-Martín RE, Houle TT, Turner DP, Smitherman TA. Perceived triggers of primary headache disorders: A meta-analysis. Cephalalgia: an international journal of headache. 2017;333102417727535. Epub 2017/08/22. https://doi.org/10.1177/0333102417727535 PMID: 28825314.

94. Walldie KE, Buckley J, Bull PN, Poulton R. Tension-type headache: A life-course review. Headache Pain Manage. 2015; 1(1):1–9.

95. Schonfeld IS, Bianchi R. Burnout and Depression: Two Entities or One? J Clin Psychol. 2016; 72(1):22–37. https://doi.org/10.1002/jclp.22229 PMID: 26451877.

96. Leiter MP, Durup J. The discriminant validity of burnout and depression: A confirmatory factor analytic study. Anxiety Stress Coping. 1994; 7(4):357–73.

97. Cresswell SL, Eklund RC. The convergent and discriminant validity of burnout measures in sport: a multi-trait/multi-method analysis. J Sports Sci. 2006; 24(2):209–20. https://doi.org/10.1080/02640410500131431 PMID: 16368631.

98. Campanini MZ, Lopez-Garcia E, Rodriguez-Artalejo F, Gonzalez AD, Andrade SM, Mesas AE. Agreement between sleep diary and actigraphy in a highly educated Brazilian population. Sleep medicine. 2017; 35:27–34. Epub 2017/06/18. https://doi.org/10.1016/j.sleep.2017.04.004 PMID: 28619179.

99. Aronsson G, Gustafsson K. Sickness presenteeism: prevalence, attendance-pressure factors, and an outline of a model for research. J Occup Environ Med. 2005; 47(9):958–66. PMID: 16155481.

100. Demerouti E, Bakker AB, Nachreiner F, Schaufeli WB. The job demands-resources model of burnout. J Appl Psychol. 2001; 86(3):499–512. Epub 2001/06/23. PMID: 11419809.

101. Schaufeli WB, Bakker AB, Job demands, job resources, and their relationship with burnout and engagement: a multi-sample study. J Organiz Behav. 2004; 25(3):293–315. https://doi.org/10.1108/026837004105001341 PMID: 16155481.

102. Schaufeli WB, Bakker AB, Job demands, job resources, and their relationship with burnout and engagement: a multi-sample study. J Organiz Behav. 2004; 25(3):293–315. https://doi.org/10.1108/026837004105001341 PMID: 16155481.

103. Schaufeli WB, Maasen GH, Bakker AB, Sixma HJ. Stability and change in burnout: A 10-year follow-up study among primary care physicians. J Occup Organ Psychol. 2011; 84(2):248–67. https://doi.org/10.1111/j.2044-8325.2010.02013.x

104. Makikangas A, Feldt T, Kinnunen U, Toivanen A. Do low burnout and high work engagement always go hand in hand?: investigation of the energy and identification dimensions in longitudinal data. Anxiety Stress Coping. 2012; 25(1):93–116. Epub 2011/04/05. https://doi.org/10.1080/10615806.2011.565411 PMID: 21462002.

105. Tadić M, Bakker AB, Oerlemans WGM. Challenge versus hindrance job demands and well-being: A diary study on the moderating role of job resources. J Occup Organ Psychol. 2015; 88(4):702–25. https://doi.org/10.1111/joop.12094

106. Goering DD, Shimazu A, Zhou F, Wada T, Sakai R. Not if, but how they differ: A meta-analytic test of the nomological networks of burnout and engagement. Burnout Research. 2017; 5:21–34. http://dx.doi.org/10.1016/j.burn.2017.05.003.