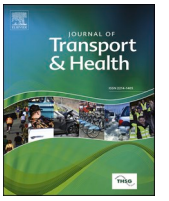
Journal of Transport & Health 36 (2024) 101804

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: www.elsevier.com/locate/jth



Mental health outcomes among urban public transport workers: A systematic literature review

Boris E. Cendales [a,*], Viviola Gómez-Ortiz [b], Sergio A. Useche [c], Leonor Cedillo [e], Daryl W.H. Stephenson [e], Paul Landsbergis [d]

[a] Faculty of Economics and Administrative Sciences, Universidad El Bosque, Ak. 9 #131a-2, 6th Floor, Edificio A, Bogota, Colombia
[b] School of Social Sciences, Psychology Department, Los Andes University, Cra. 1 #18a-12, Bogota, Colombia
[c] DATS (Development and Advising in Traffic Safety) Research Group, INTRAS (Research Institute on Traffic and Road Safety), University of Valencia, Carrer Del Serpis 29, 3rd Floor, DATS, 46022, Valencia, Spain
[d] State University of New York (SUNY)-Downstate Health Sciences University, School of Public Health, 450 Clarkson Avenue, Brooklyn, NY, USA
[e] Occupational Health Clinics of Ontario Workers, 1090 Don Mills Road, Suite 606, Toronto, Ontario, Canada

ARTICLE INFO

Keywords:
Urban public transport workers
Occupational exposures
Mental health
Organizational interventions
Literature review

ABSTRACT

Background: Although abundant evidence suggests that Urban Public Transport (UPT) workers are at high risk of poor mental health, there is no consensus on the exposures that explain these outcomes, nor on the effectiveness of mental health interventions in this occupational group.
Objective: This study aims to systematically review the literature on the mental health of UPT workers to assess the effects of occupational exposures and interventions.
Method: A systematic review was conducted following the PRISMA guidelines. The literature search was performed from 1990 to December 2021 in three databases (PubMed, Scopus, and the Web of Science). The included observational, experimental, intervention and qualitative studies were critically appraised and assessed for risk of bias. A narrative evidence synthesis was conducted by mental health outcomes, occupational exposures, and intervention categories.
Results: The database search yielded 1383 records. A total of 83 studies (49 cross-sectional, 8 longitudinal, 8 experiments, 7 interventions, and 11 qualitative) met the inclusion criteria. Bus drivers were the most studied population, followed by metro and train drivers. The included studies covered eleven mental health outcomes: sleep problems, fatigue and recovery needs, alcohol and substance use, PTSD, panic disorders, depression, anxiety, psychopathology symptoms, psychosomatic symptoms, and psychological stress. Work organization-related stressors (work content, workload and pace, working hours, participation and control, career development, status and salary, role in the organization, and interpersonal relationships) and occupational safety risks are the main predictors of negative mental health outcomes. Most intervention studies focus on the management of PTSD symptoms of UPT workers exposed to safety hazards.
Conclusion: The results of this review contribute to the consensus on the antecedents of negative mental health outcomes among UPT workers, as well as to the identification of intervention targets and promising research lines for the development of this study field.

* Corresponding author.
E-mail addresses: bcendales@unbosque.edu.co (B.E. Cendales), vgomez@uniandes.edu.co (V. Gómez-Ortiz), sergio.useche@uv.es (S.A. Useche), LCedillo@ohcow.on.ca (L. Cedillo), dstephenson@ohcow.on.ca (D.W.H. Stephenson), paul.landsbergis@downstate.edu (P. Landsbergis).

https://doi.org/10.1016/j.jth.2024.101804
Received 26 July 2023; Received in revised form 27 January 2024; Accepted 23 March 2024
Available online 23 April 2024

1. Introduction

The expansion of urban public transport (UPT) systems is a global trend, driven by the need to lower carbon emissions, noise pollution, and traffic congestion (Budd and Ison, 2020). Currently, it is estimated that the UPT industry employs 7.3 million formal workers worldwide (ILO, 2021), who provide an essential service for post-covid economic recovery (Budd and Ison, 2020; Dai et al., 2021; Docherty et al., 2021; Vickerman, 2021), especially in large cities and low-and-middle-income countries (Koehl, 2020). However, UPT employees are an occupational group exposed to hazardous working conditions, especially chemical exposures to suspended particulate matter (Gromadzinska and Wąsowicz, 2019); physical exposures to elevated temperatures, noise, and vibrations (Golinko et al., 2020); and psychosocial work exposures such as traffic congestion, conflicts with passengers and road users (including assaults), rotating shift schedules, tight time schedules, work-home conflict and witnessing traumatic events (e.g. traffic crashes or suicides) (Clarner et al., 2015; Tse et al., 2006).

Numerous studies have associated the occupational risks of UPT with the physical and mental health of workers. Most of the available evidence, focused on bus drivers, suggests that UPT working conditions are associated with cardiovascular, musculoskeletal, and gastrointestinal diseases, psychological stress, anxiety, and depression (Evans, 1994; Kompier and Di Martino, 1995; Ragland et al., 1998; Tse et al., 2006). These health outcomes are caused by direct endocrine and metabolic reactions to environmental exposures (e.g. physical and chemical hazards) (Golinko et al., 2020; Gromadzińska and Wąsowicz, 2019), or more commonly by chronic stress-related psychophysiological wear (i.e. allostatic load) (Juster et al., 2010). In turn, impaired mental health reduces attentional capacity and psychomotor control, which are essential resources for safe performance in public transportation-related tasks such as driving, passenger support and traffic control (Taylor and Dorn, 2006). Building on the accumulated knowledge about occupational exposures of UPT workers, some interventions to improve their mental health have focused on both risk removal and stress management skills (e.g. Kompier et al., 2000). However, the growing evidence on the occupational risks of UPT has not generated the expected increase in the production of evidence-based interventions and evaluative research (Tse et al., 2006), which to date remain scarce.

In previous literature reviews, four studies report that urban bus drivers have a greater risk for stress-related mental disorders, which in turn are associated with absenteeism, sick leave, and negative safety outcomes (Evans, 1994; Kompier and Di Martino, 1995; Ragland et al., 1998; Tse et al., 2006). Additionally, two systematic reviews (Clarner et al., 2015; Carey et al., 2021) have found that the exposure to traumatic events on public transportation, such as suicide and violence, increases the risk of Post Traumatic Stress Dissorder (PTSD), anxiety, and depression in train, subway, and bus drivers.

These findings consistently suggest that mental disorders represent high economic and health burdens for the UPT industry and workers. Nevertheless, previous review studies have three key limitations: i) they are focused exclusively on the working conditions and mental health outcomes of UPT drivers, preventing comparisons between occupational groups; ii) they focus primarily on the outcomes of occupational exposures, without examining the effectiveness of intervention studies; and iii) most of them (Evans, 1994; Kompier and Di Martino, 1995; Ragland et al., 1998; Tse et al., 2006) used quasi-systematic methodological designs (i.e. without an explicit research protocol), which makes them irreproducible and vulnerable to selection and interpretation bias (Pae, 2015).

To overcome the limitations of previous literature reviews, this study investigates the effects of occupational exposures and interventions on the UPT workers' mental health using a systematic approach based on the PRISMA protocol (Moher et al., 2009). In order to include a wide spectrum of outcomes, mental health was defined according to the WHO (2001) as a "state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community".

The results of this review are expected to contribute to consensus on the determinants of mental health in UPT workers, and support the formulation of evidence-based work redesign and individual mental health interventions. These efforts to improve working conditions in the UPT industry are urgently needed not only to enhance workers' health and safety, but to ensure quality of service and sustainability in a vital public service.

2. Method

2.1. Aim

Systematically review the literature to assess the effects of occupational exposures and interventions on UPT workers' mental health.

2.2. Review methodology

This study was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review protocol was registered on INPLASY (Registry code: 202,310,076.). The inclusion and exclusion criteria were set a priori and according to the Population, Intervention/Exposure, Comparison, Outcome and Study Design (PICOS) framework. In particular, the inclusion criteria were:

Population: Formal UPT workers of any age or gender, including drivers/maintainers/operators. Studies that include other occupational groups as well as UPT workers were considered eligible if separate results on the association between working conditions and UPT workers' mental health could be extracted. *Exposure/Intervention:* Physical, chemical, biological, ergonomic, safety and psychosocial work exposures; and workplace mental health interventions. *Comparison:* none. Outcomes: quantitative or qualitative

assessments of stress, well-being, psychiatric or mental health symptoms. *Study design:* Considering the methodological heterogeneity in the research field, study design inclusion criteria were not specified.

The exclusion criteria were: articles published in languages other than English; case reports, conceptual articles, editorials, letters, conference proceedings, books and book chapters, and literature reviews; articles on self-employed or informal transport workers; studies on drug testing of transport workers which do not assess mental health outcomes associated to working conditions; studies which assess safety outcomes related to working conditions or mental health problems of UPT workers; studies which assess physical health outcomes associated with the working conditions of UPT workers; and studies on stress biomarkers (as they are mechanisms that may or may not lead to mental health outcomes).

2.3. Search strategy

A comprehensive review of articles published between 1990 and 2021 was carried out. Database searches were conducted between January 24 and February 3, 2023. The electronic databases consulted were PubMed, Scopus, and the Web of Science. Preliminary searches were performed to identify free-text terms, which were combined with MeSH terms in the final search strings. Specific search strings adjusted to the field codes of each database were designed (see Appendix 1), which included the following keywords: transport, transit, bus, train, tram, railway, and subway employees/workers/drivers/maintainers/operators, mental health, anxiety, depression, burnout, stress, PTSD, wellbeing, psychological strain, psychological distress, psychological disorder, psychiatric disorder, suicide, alcohol and substance use, sleep, fatigue and need for recovery.

2.4. Study selection

Search results (bibliographic and abstract information) were stored and exported to Rayyan® online software, where duplicates were automatically removed, and full text manuscripts were uploaded in PDF format. The articles' titles and abstracts were independently reviewed by two researchers (BC, SU) to assess eligibility using the inclusion/exclusion criteria. Disagreements about the inclusion of manuscripts were resolved using the evaluation of a third reviewer (VG). The references of retrieved articles were inspected in a hand searching for additional eligible manuscripts. The selection of articles ended on February 28, 2023.

2.5. Risk of bias assessment

The methodological quality of eligible studies was assessed according to their research designs, using standardized quality-appraisal instruments. The Newcastle–Ottawa scale (NOS) was used to assess prospective (Peterson et al., 2011) and cross-sectional (Moskalewicz and Oremus, 2020) studies; the Joanna Briggs Institute (JBI) Checklist for Randomized Controlled Trials (RCTs) and Quasi-Experimental Studies were used to assess the eligible experiments and interventions; and the Critical Appraisal Skills Program Qualitative Research Checklist (CASP, 2018) was used to assess eligible qualitative studies. The general scores of the appraisal tools were calculated by adding the corresponding items. Scores on each specific NOS domain were also provided. In all cases, a higher score

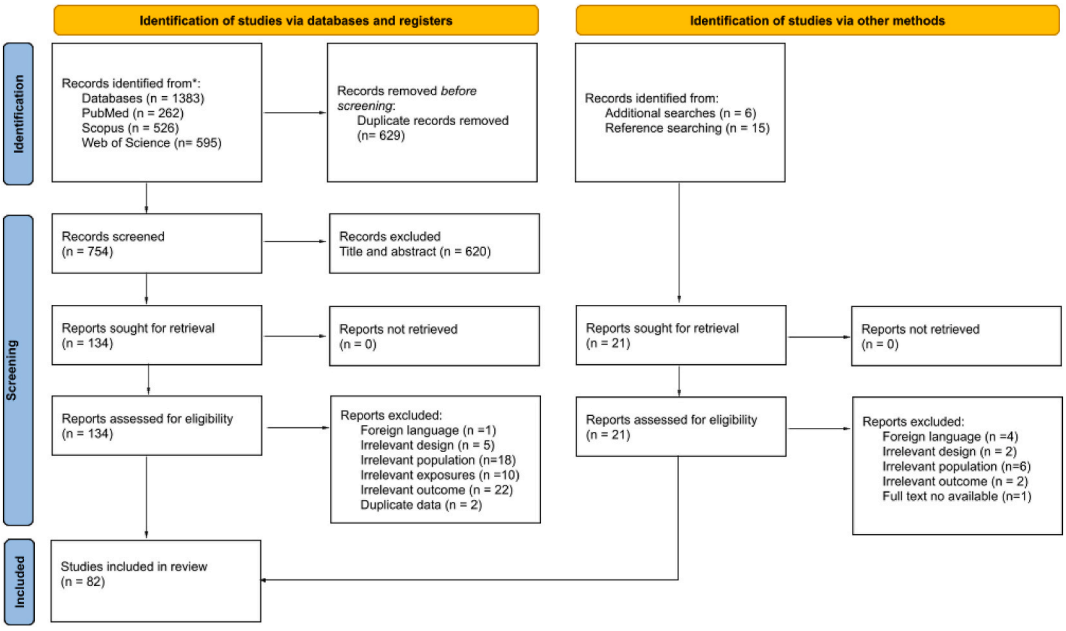


Fig. 1. Study selection PRISMA Flow Diagram.

Table 1
Characteristics of included observational Studies.

Authors	Country	Study design	Occupation	Sample	Focus: to associate … (exposures *with* outcomes)	Selection	Comparability	Outcome	NOS score*
Alrukaibi and Koushki (2008)	Kuwait	X–S	Bus drivers	n = 486 (100% male, M_{age} = 43.2)	Working hours and overtime with fatigue.	3	0	2	5
Anund et al. (2016)	Sweden	X–S	Bus drivers	n = 231 (74% male, M_{age} = 51)	Shift schedule with sleepiness.	3	2	2	7
Asaoka et al. (2012)	Japan	X–S	Professional and non-professional drivers	n = 4081 (74% male, M_{age} = 42.4)	Occupational group with sleep disorders.	3	1	2	6
Batool et al. (2022)	Pakistan	X–S	Bus drivers	n = 499 (100% men, M_{age} = 47.08)	ERI model, bus ergonomics and safety culture with burnout.	1	2	2	5
Bruno et al. (2013)	Brazil	X–S	Bus drivers	n = 200 (100% male, M_{age} = 43.7)	Noise exposure with sleep quality.	2	1	1	4
Buitendach et al. (2016)	Zimbawe	X–S	Bus drivers	n = 283 (100% male)	JDR model with burnout.	3	2	2	7
Byun et al. (2016)	Korea	X–S	Subway drivers	n = 980 (100% male)	JDC model and specific subway driving stressors with suicide ideation.	3	1	2	6
Carrère et al. (1991)	USA	X–S	Bus drivers	n = 60 (100% male, M_{age} = 39.0)	JDC model with psychological stress.	1	2	2	5
Cendales et al. (2014)	Colombia	X–S	Bus drivers	n = 139 (100% male, M_{age} = 40.01)	JDC-S model and ERI model with psychological strain.	3	2	2	7
Chaiard et al. (2019)	Thailand	X–S	Bus drivers	n = 139 (100% male, M_{age} = 45.8)	Shift schedule with sleep quality.	3	2	2	7
Chen and Cunradi (2008)	USA	X–S	Transit workers	n = 1231 (83% male, M_{age} = 46.4)	Job hassle stress with burnout and alcohol use.	4	2	2	8
Chen and Hsu (2020)	Taiwan	X–S	Bus drivers	n = 324 (96% male)	Role stressors (overload and WFC), organizational and supervisor support with emotional exhaustion.	3	2	2	7
Chung and Wong (2011)	Taiwan	X–S	Bus drivers	n = 785 (98% male, M_{age} = 42.15)	ERI model and safety culture with sleep quality, burnout and depression.	3	2	2	7
Chung and Wu (2013)	Taiwan	X–S	Bus drivers	n = 927 (96.21 % male, M_{age} = 39.97)	ERI model with burnout and general health.	3	2	2	7
Cunha et al. (2016)	Brazil	X–S	Bus drivers	n = 1607 (87.3 % male)	Working hours, overtime, working conditions, traffic, safety threats and traffic crashes with alcohol abuse.	3	2	2	7
Cunradi et al. (2019)	USA	X–S	Transit workers	n = 935 (56% male)	Job stressors, shift schedule and working hours with sleep problems.	3	0	2	5
Diez et al. (2011)	Argentina	X–S	Bus drivers	n = 47 (100% male, M_{age} = 39.51)	Shift schedule with sleep quality.	4	2	1	7
Diez et al. (2014)	Argentina	X–S	Bus drivers	n = 1023 (all >40 years)	Rest time with sleep quality/sleepiness	3	0	2	5
Doroga and Băban (2013)	Romania	X–S	Train drivers	n = 193 (100 % male, M_{age} = 38.42)	PUT experience and # of PUTs with PTSD.	4	1	2	7
Duffy and McGoldrick (1990)	U.K.	X–S	Bus drivers	n = 376 (100% male)	Work stress with mental health symptoms.	4	0	1	5
Gershon et al. (2021)	USA	X–S	Transit workers	n = 645 (82% male)	Anti-COVID measures with mental health symptoms.	3	0	2	5
Hu and Chen (2019)	Taiwan	X–S	Bus drivers	n = 308 (95% male)	Working conditions, mixed traffic flow, and dealing with elder passengers with physical and mental fatigue.	3	0	2	5
Ihlström et al. (2017)	Sweden	X–S	Bus drivers	n = 232 (75% male, Mage = 51.0)	Split shifts with psychological stress and sleep quality.	3	1	1	5

(*continued on next page*)

Table 1 (*continued*)

Authors	Country	Study design	Occupation	Sample	Focus: to associate … (exposures *with* outcomes)	Selection	Compara-bility	Outcome	NOS score*
Jo et al. (2010)	Korea	X–S	Subway drivers	n = 821 (99% male)	Safety events with depression.	3	1	2	6
Jones et al. (2020)	USA	X–S	Rail operators	n = 127 (60% male, M_{age} = 44)	Rest facilities availability and usage time with fatigue and depression.	3	2	2	7
Joshi and Vaidya (2017)	India	X–S	Bus drivers	n = 266 (100 % male, Mage = 49)	Occupation with psychological stress.	1	0	1	2
Kim et al. (2013)	Korea	X–S	Subway drivers	n = 826 (100% male, n = Mage = 37.9)	PUT experience, when PUT was experienced and # of PUTs with PTSD, MDD and panic disorder.	4	2	2	8
Kim et al. (2013)	Korea	X–S	Subway drivers	n = 833 (100% male, M_{age} = 37.9)	PUT experience with PTSD, MDD with panic disorder.	4	1	2	7
Kim et al. (2014 [3])	Korea	X–S	Subway drivers	n = 980 (100% male)	Traumatic work incidents with PTSD, MDD and panic disorder.	3	0	2	5
Lee et al. (2017)	Korea	X–S	Bus drivers	n = 332 (100% male, Mage = 48.9)	Shift schedule with sleep quality.	3	2	2	7
Lee et al. (2019)	Korea	X–S	Bus drivers	n = 347 (95.4% male)	Work–life balance with depression, anxiety, insomnia and alcohol abuse.	2	2	2	6
Lin et al. (2003)	Taiwan	X–S	Bus and Self-employed drivers	n = 1011 (95% male, Mage = 47.3)	Occupation with psychological stress.	3	0	1	4
Lopez-Simoes et al. (2019)	Brazil	X–S	Bus drivers	n = 1609 (99% male)	Job precariousness with common mental disorders	3	2	2	7
Machin and Hoare (2008)	Australia	X–S	Bus drivers	n = 159 (98.7% male)	Driving hours (week) with need for recovery.	1	1	2	4
Malt et al. (1993)	Sweden and Norway	X–S	Train drivers	n = 101 (93% males, M_{age} = 40.2)	PUT experiences with PTSD.	3	0	2	5
Miller et al. (2020)	UK	X–S	Bus drivers	n = 1335 (86% male, M_{age} = 45.09)	Shift schedule and commute time with sleep quality.	3	2	2	7
Onninen et al. (2020)	Finnland	X–S	Tram drivers	n = 23 (52,17% males)	Shift schedule with sleepiness	1	1	2	4
Ragland et al. (2000)	USA	X–S	Transit workers	n = 1386 (83% male)	Working conditions and alcohol use.	4	2	2	8
Ragland et al. (1995)	USA	X–S	Transit workers	n = 1853 (83% male)	Working conditions and alcohol use.	3	2	2	7
Risco et al. (2013)	Peru	X–S	Bus and auto rickshaw drivers	n = 434 (96% males, M_{age} = 35.0)	Working hours (day and night) with sleepiness, depression, anxiety, and alcohol abuse.	3	0	2	5
Samerei et al. (2020)	Iran	X–S	Subway drivers	n = 96 (100%male, M_{age} = 32.96)	Occupational safety with depression.	2	1	1	4
Simões et al. (2019)	Brazil	X–S	Bus drivers	n = 1607 (99% male)	Working hours (week) with common mental disorders, sleep disorder and depression.	3	2	2	7
Tse et al. (2007)	UK	X–S	Bus drivers	n = 186 (100% males, M_{age} = 46.00)	ERI model and work pressure with psychological strain and somatic symptoms.	3	0	2	5
Tu et al. (2021)	China	X–S	Bus drivers	n = 310 (94.1 male, Mage = 45.6)	Driver-passenger communicative stress with psychological strain, emotional exhaustion and cynism.	4	2	2	8
Useche et al. (2017)	Colombia	X–S	Bus drivers	n = 524 (100% males, M_{age} = 40.60)	JDC-S and ERI models with need for recovery and fatigue.	3	2	2	7
Vatshelle and Moen (1997)	Norway	X–S	Train drivers	n = 830	Traumatic events with global health status.	4	1	1	6
Yum et al. (2006)	Korea	X–S	Train drivers	n = 639 (100% male)	PUT experience with PTSD.	3	0	1	4
Zhang et al. (2016)	China	X–S	Train drivers and conductors	n = 784 (70.7% males)	Shift schedule with HRQL and general health.	2	1	0	3

(*continued on next page*)

Table 1 (*continued*)

Authors	Country	Study design	Occupation	Sample	Focus: to associate … (exposures *with* outcomes)	Selection	Compara-bility	Outcome	NOS score*
Cothereau et al. (2004)	France	CH	Train drivers	Exposed (100% male, Mage = 39.1): n = 202 Non-exposed (100% male, M_{age} = 39.0): n = 186	PUT experience with PTSD and psychological strain.	4	2	3	9
Karlehagen et al. (1993)	Norway and Sweden	CH	Train drivers	Sickleve ≤ 1 week: n = 85 Sickleave >1 week: n = 11	PUT experience with PTSD.	4	0	2	6
Härmä et al. (2002)	Finland	CH	Rail workers (divers and controlers)	Train drivers: n = 126 Train controllers: n = 104	Shift schedule with sleepiness.	3	2	2	7
Limosin et al. (2006)	France	CH	Train drivers	Exposed (100% male, M_{age} = 39.1): n = 202 Non-exposed (100% male, M_{age} = 39.0): n = 186	PUT experience with psychiatric disorders.	4	2	3	9
Onninen et al. (2021)	Finland	CH	Tram and truck drivers	Tram drivers: n = 23 (52% male, M_{age} = 40.6) Truck drivers: n = 52 (98% male, M_{age} = 40.1)	Shift schedule and rest time with sleepiness.	2	2	3	7
Rydstedt et al. (1998)	Sweden	CH	Bus drivers	Men: n = 35 (M_{age} = 41.4) Women: n = 17 (M_{age} = 44.5)	Workload with spillover of fatigue to leisure activities and Consumption of pharmacological substances.	2	1	3	6
Wagner et al. (2014)	USA	CS	Bus drivers	n = 78 (56% males, M_{age} = 52.0)	Daily surface acting with state anxiety, emotional exhaustion and insomnia.	3	NA	3	6
Zhou et al. (2018)	Canada	CS	Bus drivers	n = 109 (57% male, M_{age} = 44.4)	Violent event at work with PTSD.	3	NA	3	6

Note: X–S: Cross-sectional; CH: Cohort study; CS: Case series. *See the scores on each NOS item in Appendix 2 JDC: Job Demands Control; JDC-S: Job Demands Control-Support; JDR: Job Demands Resources; ERI: Effort-Reward Imbalance; WFC: Work-Family Conflict; MDD: Major Depressive Disorder; HRQL: Health-Related Quality of Life; PUT: Person Under Train; PTSD: Post-Traumatic Stress Disorder.

Table 2
Synthesis of observational evidence on the associations between occupational exposures and mental health outcomes among UPT workers.

MH outcome	Population/exposures	Exposure category
Sleep problems	*Bus drivers:*	
	Resting time along the working day (Diez et al., 2014), post-lunch and last driving periods (Lee et al., 2017), insufficient time to eat during breaks (Miller et al., 2020), insufficient time to rest during breaks (Miller et al., 2020), working hours/day, working hours/week, working over 45 h/week, over running of routes, late running of buses, commuting time, split shift hours (Anund et al., 2016; Miller et al., 2020), 6 or more days without rest (Miller et al., 2020), less than 11 h rest (Anund et al., 2016; Miller et al., 2020), more than 10 h overtime (Anund et al., 2016; Miller et al., 2020), variation of starting time, short notice of shifts (Anund et al., 2016), driving hours per route, rest time during route, switching drivers during route, routes per day (Chaiard et al., 2019). Work shifts: Split-Y/N (Ihlström et al., 2017), morning/afternoon, fixed/rotating (Miller et al., 2020), day/night/day or night (Chaiard et al., 2019), morning/evening/night hours (Risco et al., 2013).	Working hours
	Effort (Chung and Wong, 2011)	Workload and work pace
	Rewards (Chung and Wong, 2011)	Career development, status and pay
	Safety culture (Chung and Wong, 2011)	Organizational culture
	Work-home balance (Lee et al., 2019)	Work-home interface
	Surface-acting (Wagner et al., 2014)	Job content
	Lack of rest areas, Lack of siting places (Miller et al., 2020), Noise (Bruno et al., 2013)	Physical exposures
	Occupational group (bus divers vs.): auto-rickshaw drivers (Risco et al., 2013); autolocksmiths, joiner's shop workers, electromechanics, and other UPT workers; non-professional drivers (Asaoka et al., 2012).	–
	Transit workers:	
	Time to unwind (Curandi et al., 2019), week working hours, work shifts: morning/evening/night hours (Curandi et al., 2019).	Working hours
	Job stress (Curandi et al., 2019)	Job content
	Train/Tram drivers	
	Work shifts: Day/Nigth x rest time: shift beginning/end (Onninen et al., 2020), evening/night/morning/day, shift length (Härmä et al., 2002).	Working hours
	Occupational group (tram divers vs.): truck drivers (Onninen et al., 2020)	–
Fatigue and need for recovery	*Bus drivers*	
	Working days, overtime shifts/week (Alrukaibi and Koushki, 2008). Split-shifts: Y/N (Ihlström et al., 2017)	Working hours
	Dealing with elder passengers, Mixed traffic flow (Hu and Chen, 2019)	Job content
	Workload (Machin and Hoare, 2008; Rydstedt et al., 1998)	Workload and work pace
	Job Strain (Useche et al., 2017)	Job content; workload and work pace; participation and control
	Effort-Reward Imbalance (Useche et al., 2017)	Workload and work pace; career development, status and pay
	Social support (Useche et al., 2017)	Interpersonal relationships
	Work related factors (Hu and Chen, 2019)	Working hours; career development, status and pay
	Train drivers	Interpersonal relationships
	Breakroom usage time (Jones et al., 2020)	Working hours
	Break room quality: air, vibration, maintenance (Jones et al., 2020)	Physical exposures
Burnout symptoms	*Bus drivers*	
	Effort-Reward Imbalance (Batool et al., 2022; Chung and Wong, 2011; Chung and Wu, 2013).	Workload and work pace; career development, status and pay
	Safety culture (Batool et al., 2022)	Organizational culture
	Job demands (Buitendach, et al., 2016)	Workload and work pace
	Role overload (Chen and Hsu, 2020)	
	Job resources (Buitendach, et al., 2016)	Job content
	Work-family conflict (Chen and Hsu, 2020)	Home-work Interface category
	Driver-passenger communicative stress (Chen and Hsu, 2020), Supervisory support (Chen and Hsu, 2020)	Interpersonal relationships
	Transit workers	
	Job hassle stress (Chen and Cunradi, 2008)	Job content

(*continued on next page*)

Table 2 (*continued*)

MH outcome	Population/exposures	Exposure category
Alcohol and substances use	*Bus drivers*	
	Work-life balance (Lee et al., 2019)	Home-work interface
	Aggressions at work (Cunha et al., 2016).	Interpersonal relationships category
	Alternation of working hours, overtime, working during holidays (Cunha et al., 2016)	Working hours
	Traffic (Cunha et al., 2016)	Job content stressors
	Personal security threats at work: last year, traffic crashes: last year (Cunha et al., 2016)	Occupational safety risk
	Vibration, uncomfortable temperature, inadequate lighting, internal and external noise (Cunha et al., 2016)	Physical exposure
	Workload (Rydstedt et al., 1998)	Workload and work pace
	Occupational group (bus divers vs.): auto-rickshaw drivers (Risco et al., 2013), self-employed drivers (Lin et al., 2003).	–
	Transit workers	
	Job stress (Ragland et al., 1995; 2000), job strain (Ragland et al., 1995)	Workload and work pace; interpersonal relationships; working hours; job content; organizational culture; occupational safety risks
	Job hassle stress: via burnout and disengage-deny coping (Chen and Cunradi, 2008)	Job content
Post-traumatic stress disorder	*Bus drivers*	
	Violent event at work (Zhou et al., 2018)	Occupational safety risk
	Train/subway drivers	
	Personal PUT incident (Cothereau et al., 2004; Doroga and Băban, 2013; Kim et al., 2013a; 2013b; 2014; Malt et al., 1993), colleagues' PUT incident (Kim et al., 2014), # of PUT incidents (Kim et al., 2013b, 2014), when PUT was experienced, severity of PUT victim's injury (Kim et al., 2013b), >1 week PUT-related sick-leave (Karlehagen et al., 1993), conflict with passengers, sudden stop from an emergency bell, near safety incidents (Kim et al., 2014), experience of a breakdown (Kim et al., 2014).	Occupational safety risk
Panic disorder	*Train/subway drivers*	
	Personal PUT incidents (Kim et al., 2013; 2013b), colleagues' PUT incident (Kim et al., 2014), when PUT was experienced,# PUT experiences, severity of victim's injury (Kim et al., 2013b), # of PUT experiences, conflict with passengers, near safety incidents, experienced a sudden stop, and experienced a breakdown (Kim et al., 2014).	Occupational safety risk
Depression	*Bus drivers*	
	Effort-reward imbalance (Chung and Wong, 2011),	Workload and work pace, and career development, status and pay
	Work-life balance (Lee et al., 2019)	Home-work interface
	Job precariousness (Simões et al., 2019)	–
	Train/subway drivers	
	Personal PUT incidents (Kim et al., 2013; 2013b, 2014), conflict with a passenger, sudden stop from an emergency bell, near safety incidents (Jo et al., 2010), perceived risk of emergency situations (Samerei et al., 2020).	Occupational safety risk
	Workplace health promotion actions (Jones et al., 2020)	–
Anxiety	*Bus drivers*	
	Work-life balance (Lee et al., 2019)	Home-work interface
	Surface-acting (Wagner et al., 2014)	Job content
	Occupational group (bus divers vs.): auto-rickshaw drivers (Risco et al., 2013)	–
Psychopathology symptoms	*Bus drivers*	
	Job strain (Cendales et al., 2014)	Job content; workload and work pace; participation and control
	Social support (Cendales et al., 2014), poor management support (Tse, et al., 2007).	Interpersonal relationships

(*continued on next page*)

Table 2 (*continued*)

MH outcome	Population/exposures	Exposure category
	Effort/reward imbalance (Cendales et al., 2014)	Workload and work pace; career development, status and pay
	Practical job problems: Traffic, Peack running times, passengers and fares, poor treatment by passengers, Enquires from the public, route learning, assault (Duffy and McGoldrick, 1990)	Job content; workload and work pace; occupational safety risk; role in the organization
	Effort (Tse, et al., 2007)	Workload and work pace
	Rewards (Tse, et al., 2007)	Career development, status and pay
	Adverse road conditions and passenger behavior (Tse, et al., 2007), driver-passenger comunicative stress (Tu et al., 2021).	Job content
	Work precariousness (Lopes-Simoes et al., 2019)	–
	Occupational group (bus divers vs.): self-employed drivers (Lin et al., 2003).	–
	Train/subway drivers	
	Personal PUT incidents (Cothereau et al., 2004; Limosin et al., 2006), distressing on-the-track events (Vatshelle and Moen, 1997).	Occupational safety risk
Psychosomatic symptoms	*Bus drivers*	Workload and work pace
	Workload (Rydstedt et al., 1998), Effort (Tse, et al., 2007)	
	Rewards (Tse, et al., 2007)	Career development, status and pay
	Adverse road conditions and passenger behavior (Tse, et al., 2007)	Job content
Psychological stress	*Bus drivers*	
	Job strain (Carrère et al., 1991)	Job content; workload and work pace; participation and control
	Split-shift Y/N (Ihlström et al., 2017)	Working hours
	Occupational group (bus divers vs.): office staff (Joshi and Vaidya, 2017).	–
	Transit workers	
	More than 8 h overtime (Vytautas and Daiva, 2003)	Working hours

Note: Underlined references provide significant evidence on the association between exposure and mental health outcome. PUT: Person Under Train

suggests higher methodological quality. The most frequent methodological biases were described for each research design. The scores obtained by the revised articles in each item of the appraisal tools are available in Appendix 2. The quality appraisal was conducted by CB, US and VG. Disagreements between reviewers were resolved by consensus. The risk of bias assessment was conducted after data extraction to avoid reporting bias (Boland et al., 2017).

2.6. Data extraction and evidence synthesis

According to the PICOS framework, the data extraction process included population (country, city, occupation, age, gender), intervention (if applicable) or exposure, comparisons (if applicable), outcomes, and study design. Due to the methodological heterogeneity within the included studies, a narrative approach was used to synthesize evidence. Occupational exposures were summarized using predefined categories differentiating physical, chemical, biological, ergonomic, safety and psychosocial risks. The latter were classified according to the WHO Organizational Stress-related Hazard Categorization (job content, workload and work pace, working hours, participation and control, career development, status and pay, role in the organization, interpersonal relationships, organizational culture, and work-home interface) (Leka et al., 2004). Interventions were categorized according to their individual or job-redesign approach. Subsequently, the outcomes of occupational exposures and interventions were reported according to eleven emerging categories: sleep problems, fatigue and need for recovery, alcohol and substance use, PTSD, panic disorders, depression, anxiety, psychopathology symptoms, psychosomatic symptoms, and psychological stress. Finally, qualitative evidence was analyzed using Thomas and Harden's (2008) thematic synthesis method. Data extraction was conducted by CB, US and GV, and information synthesis was jointly performed by the entire team of researchers. The review process ended on July 28, 2023.

3. Results

Fig. 1 shows the study selection process. The database search yielded 1383 records. After automatic deduplication in Rayyan, 743 studies were retained. After title and abstract screening, 137 studies were retained. Subsequently, 58 records were excluded and 79 studies meeting the inclusion criteria were retained in the full-text evaluation (See studies excluded after full-text evaluation in appendix 2). Additional searches and reference inspection yielded 21 records, of which 3 studies were retained after full-text assessment. A total of 82 studies were included in the review.

3.1. Study characteristics and risk of bias

The characteristics of the 82 included studies are summarized in Table 1. Most of them (n = 48) have a cross-sectional design, 8 have longitudinal designs (6 cohort studies and 2 case series), 15 have experimental designs (8 experiments and 7 interventions), and

Table 3
Characteristics of included experimental studies.

Authors	City	Design	Occupations	M_{age}	Sample	Mental health outcomes	Manipulations	Comparisons	JBI-Checklist score*
Anund et al. (2018)	Sweden	ORM	Bus Drivers	48	n = 18 (50% males)	Sleepiness: KSS Drowsiness: EEG-KDS Blink duration: EOG	Consecutive 50 min. Driving	Split shifts vs. Afternoon shifts	7
Brandenburger et al. (2021)	Germany	RCT	Train drivers	37.13	Partially assisted driving: n = 13 (males) Fully assisted driving: n = 19 (males)	Sleepiness: KSS	2 h of simulated driving with automatic conduction technology	Pre-test vs. Post-test Partially assisted driving vs. Fully assisted driving	8
Huang et al. (2019)	China	ORM	Metro Drivers	27.8	n = 6 (males)	Fatigue: HRV	Consecutive 7 h driving	Day vs. night vs. Morning shift	8
Ingre et al. (2004)	Sweden	ORM	Train drivers	50	n = 17 (males)	Sleepiness: KSS	9 h driving with a 2.5 h break in between	Early morning vs. Day vs. Evening shifts	7
Iridiastadi (2021)	Indonesia	ORM	Train drivers	28.9	n = 32 (males)	Sleepiness: KSS Fatigue: Visual analogue scale	Consecutive 6.5 h driving	Morning vs. Afternoon shifts	7
Jay et al. (2008)	Australia	ORM	Train drivers	51.3	n = 9 (males)	Fatigue: SPFC	Consecutive driving shifts in two different roster types	Roster 1: Shift 1 (S1): 8 h driving/8 h rest; S2: 8 h driving/8 h rest, S3: 8 h driving/8 h rest; S4: 8 h driving/8 h rest; S5: 8 h driving/8 h rest; 3-day rest. Vs. Roster 2: Shift 1 (S1): 8 h rest/8 h driving; S2: 8 h rest/8 h driving; S3: 8 h rest/8 h driving; S4: 8 h rest/8 h driving; S5: 8 h rest/8 h driving, 3-day rest.	7
Milosevic (1997)	Serbia	ORM	Bus Drivers	NR	n = 7 (males)	Fatigue: HR Subjective fatigue: PBFFC	Consecutive driving	1 h vs. 2 h vs. 3 h … vs. 7 h	5
Sun, et al. (2018)	China	ORM	Bus drivers	NR	n = 680 (79.2% males)	Tension: POMS Depression: POMS Vigor: POMS	Consecutive driving times at high temps: <1 h, 1–2 h, 2–3 h, 3–4 h	<1 h vs. 1–2 h vs. 2–3 h vs. 3–4 h	8

Note: ORM: One-group repeated measures design. RCT:Randomized controlled trial. KSS: Karolinska Sleepiness Scale, EEG-KDS: EEG-based Karolinska Drowsiness Score; EOG:Electrooculography; HR: Heart Rate; HRV: Heart Rate Variability; SPFC: Samn–Perelli Fatigue Checklist; PBFFC: Pearson-Byars Fatigue Feeling Checklist; POMS: Profile of Mood States. NR: Not reported. *See the scores on each JBI-Checklist score item in Appendix 2.

Table 4
Characteristics of included intervention studies.

authors	Country	Design	Occupations	M_{age}	Sample	Intervention	Duration	Mental health outcomes	JBI-Checklist score*
Bender et al. (2016)	Canada	Quasiexperimental, pre-post design, with control group.	Transit workers	45.1	Treatment-as-Usual: n = 62 Best Practice Intervention: n = 79	Education on response to trauma, symptoms of PTSD, treatment options, and appropriate resources. CBT and/or pharmacologic treatment + occupational therapy, physiotherapy, consulting psychiatric care, and return-to-work coordination. Specialized return to work strategies.	24 weeks	PTSD symptoms: MPSS	8
Evans et al. (1999)	Sweden	Quasiexperimental, pre-post design, with control group.	Bus drivers	42.6	Drivers on the experimental line: n = 10 Controls: n = 31	Construction of separate bus lanes for the most congested portions of the route; reconfiguration of parts of the route to minimize difficult turns and bottlenecks; the construction of passenger peninsulas wherever possible to bring the public out to the bus and avoid pullovers to the curb; the installation of a traffic signal priority system favoring the bus; and the design and installation of an electronic information system	20 weeks	Perceived stress: SES	8
Lowinger and Rombom (2012)	USA	Single group pre-post design	Transit workers	43.81	n = 96	CBT (relaxation training, self-instructional skills, desensitization training, and behavioral assignments)	Variable: 3 to 145 treatment sessions. Mean = 19.55	PTSD symptoms: PCL-C and PTSD scale	6
Mehnert et al. (2012)	Germany	Quasiexperimental, pre-post design.	Train Drivers	48	Patients with 1 emergency situation n = 51 Patients with >1 emergency situation: n = 22	The rehabilitation program included education, exercises and physical therapy to regain physical fitness, relaxation training, psychosocial counseling, and cognitive-behavioral group therapy as well as individual cognitive-behavioral interventions and resource-oriented recreational activities.	4 weeks	Depression and anxiety: HADS Psychological distress: DT HRQL: (SF-8) Sense of coherence and lack of meaning in life: (LAP-R) Posttraumatic stress: PDS	7
Nakamura et al. (2018)	Japan	Single group pre-post design	Train Drivers	33.22	n = 134	Forty days practicing three behaviors (selected independently by each participant) from the sleep-promoting behaviors checklist.	40 days	Sleep Log	5
Poulsen et al. (2007)	Denmark	Mixed. The cuantitative component used a multiple case-based cohort design.	Bus drivers	NR	Baseline survey: n = 2677	Garage 1. Round-the-clock work at the garage + faster renovation of old buses + new buses + priority of common problems.	4 years	Somatic stress, Cognitive stress, and	6

(*continued on next page*)

Table 4 (*continued*)

authors	Country	Design	Occupations	M_{age}	Sample	Intervention	Duration	Mental health outcomes	JBI-Checklist score*
					Follow-up survey: n = 2729	Garage 2. Feedback from garage to drivers + new buses. Garage 3. Improved communication between driver and garage + feedback from garage to drivers. Garage 4. Improved fault reporting + communication. Garage 5. Know your bus course + garage visits + more resource at the garage + feedback. Garage 6. Meetings with focus on collaboration between driver and garage + bulletin board with technical information. Garage 7. New buses + new drivers' seats.		Vitality reduced: Scales developed by authors	
Zhong et al. (2021)	China	Single group pre-post design	Bus drivers	43.66	n = 86	On-duty bus drivers received, in addition to a typical lunch box (no fruit included), an extra serving of fresh fruit like an apple or a banana.	4 weeks	Depression: PHQ-8	5

Note: MPSS: Modified PTSD Symptoms Scale; SES: Stress/Energy Scale; PCL-C: PTSD CheckList – Civilian Version; HADS: Hospital Anxiety and Depression Scale; DT: Distress Thermometer; SF-8: Short Form Health-Related Quality of Life; LAP-R: Life Attitude Profile-revised; PDS: Posttraumatic Diagnostic Scale. *See the scores on each JBI-Checklist score item in Appendix 2.

Table 5
Characteristics of included qualitative studies.

Authors	Country	Study aim	Data collection	Data Analysis	Occupations	M_{age}	Sample	Mental health Issues	CASP Score*
Biggs et al. (2009)	Australia	To investigate which work and environmental factors may cause fatigue in metropolitan bus drivers.	Focus groups	Thematic analysis	Transit workers (Bus Drivers, trainers, assessors, and customer service consultants)	NR	NR	Fatigue	7
Bowles et al. (2017)	USA	To identify issues in the work environment that contribute to stress and present as barriers to achieving optimal health.	In-depth interviews	Grounded theory	Transit workers (bus and subway, conductors; agents and cleaners at stations, maintenance)	45–70	n = 32	Fatigue	9
de Alcantara et al. (2019)	Brazil	To describe the perceptions of bus drivers about their experience in traffic and the possible effects of daily urban mobility on these drivers.	Semi-structured interviews	Phenomenological analysis	Bus drivers	NR	n = 24	Psychological stress	10
de Alcantara et al. (2020)	Brazil	To discuss the experience of bus drivers through their perceptions regarding traffic and the health impacts they suffer.	Semi-structured interviews	Phenomenological descriptive methodology	Bus drivers	NR	n = 24	Psychological stress	7
Maynard et al. (2021)	UK	To explore bus driver opinion relating to their experience of bus driving and how fatigue influences or is influenced by this, and how this is managed.	Focus groups	Thematic analysis	Bus drivers and managers	25–64	n = 64	Fatigue and sleepiness countermeasures	9
Maynard et al. (2021)	UK	To investigate interactions and working relationships between bus controllers and drivers in London and to explore the effect of controller/ driver relationships on workload, stress and fatigue	Focus groups	Thematic analysis	Bus traffic controllers	35–44	n = 36	Controller fatigue, controller perceptions of driver fatigue and reporting, and controller wellbeing	10
Naweed et al. (2017)	Australia	To examine the impacts of key barriers to improving the occupational health status of Australian train drivers.	Focus groups	Thematic analysis	Train drivers	46.5	n = 29	Stress and axiety	10
Peters et al. (2021)	Chile	To identify working conditions and health outcomes in a bussing company to inform a Total Worker Health organizational intervention	Semi-structured interviews and focus groups	Thematic analysis	Transit workers focus groups: Bus drivers. Interviews: company leadership, operations and safety managers, union directors, and worker representatives.	NR	NR	Fatigue and psychological stress	9
Pilkington-Cheney et al. (2020)	UK	Understand the experiences, views, and opinions of the bus drivers in relation to sleepiness, and individual countermeasures used to manage sleepiness in their professional setting.	Focus groups	Thematic analysis	Bus drivers	45–54	n = 62	Fatigue	10
Poulsen et al. (2007)	Denmark	Develop an evaluative framework for complex health interventions in transport workers.	Observational methods.	Discourse and dilemma analyses	Bus drivers	NR	NR	Psychological stress	9
Sidhu and An (2019)	USA	To explore split shifts as a health and safety concern for bus operators	Semi-structured interviews	Thematic analysis	Bus drivers	35–44	NR	Psychological stress	9

Note: *See the scores on each JBI-Checklist score item in Appendix 2. NR: not reported

11 have qualitative designs. Just one RCT meets the inclusion criteria. Geographically, 14 studies are from North America, 30 studies are from Europe, 24 are from Asia, 9 from South America, 4 from Oceania and 1 from Africa.

The included studies covered a total of 35,616 participants with an unweighted average age of 41.8, with mean ages ranging between 27 and 52 years across studies. Those studies reporting gender covered a total of 27,747 men and 7662 women. Only two studies were found comparing male and female bus drivers (Rydstedt et al., 1998; Zhou et al., 2018). In single-occupation studies, bus drivers are the most studied population (n = 18,508), followed by subway (n = 4536) and train (n = 2146) drivers. One study focuses on tram drivers (Onninen et al., 2020), one study on traffic controllers (Maynard et al., 2021), and one study on train operators (Jones et al., 2020). Eleven (11) mixed occupation studies combine various occupational groups (e.g., mechanics, maintainers, collectors) in samples of "transit workers" (n = 4834).

Two cross sectional studies (Obelenis and Gedgaudienė, 2003) comparing formal UPT occupational groups were found. One compares bus drivers, autolocksmiths, joiner's shop workers, and electromechanics (Obelenis and Gedgaudienė, 2003); and the other compares ground workers, train drivers and conductors (Zhang et al., 2016). Additionally, one cross sectional study compares bus drivers with self-employed drivers (Lin et al., 2003), and another with auto rickshaw drivers (Risco et al., 2013); one cohort study compares tram drivers with truck drivers (Onninen et al., 2021); and two cross sectional studies compare bus drivers with various non-UPT occupations (Asaoka et al., 2012; Obelenis and Gedgaudienė, 2003).

Of 56 observational studies, 28 obtained NOS scores in the good quality range, 4 in the fair quality range, and 24 in the poor quality range. All longitudinal studies except one (Karlehagen et al., 1993) are of good quality. Most of them investigated PTSD outcomes associated with the exposure to work-related traumatic events, using one to three-year follow-ups (Cothereau et al., 2004; Limosin et al., 2006; Karlehagen et al., 1993; Zhou et al., 2018). Three daily measurement studies evaluated sleepiness and psychological strain of workers during two (Onninen et al., 2021; Wagner et al., 2014) and three weeks (Härmä et al., 2002); and a cohort study on workload-related somatic symptoms carried out two follow-up measurements with 18 months between them (Rydstedt et al., 1998). The NOS domain with the highest risk of bias among longitudinal studies was comparability, followed by selection and outcome/exposure (see Table 1).

In the case of experimental studies, one scored 8/9 on the JBI checklist for quasi-experimental studies, five scored 7/9 and one 5/9. The experimental study by Brandenburger et al. (2021) scores 8/13 on the JBI checklist for RCTs (see Table 3). The main risk of bias among quasi-experimental studies was the non-use of a control group. In one study (Milosevic, 1997) it is not clear whether the participants included in the comparisons are similar, nor are the statistical analysis reported. On the other hand, two intervention studies scored 8/9, four scored 5/9 and one 7/9 (See Table 4). Only two of six interventions used a control group (Bender et al., 2016; Evans et al., 1999). Three intervention studies failed to properly analyze and describe the differences between groups in terms of follow-up (Lowinger and Rombom, 2012; Poulsen et al., 2007; Zhong et al., 2021); and 3 studies omitted essential statistical information in the results report (Bender et al., 2016; Evans et al., 1999; Poulsen et al., 2007).

Regarding qualitative research, 4 studies scored 10/10 on the CASP Checklist, 5 studies scored 9/10, and two studies scored 7/10 (see Table 5). Four studies were assessed as of little value to the research field (Biggs et al., 2009; Bowles et al., 2017; de Alcantara et al., 2020; Maynard et al., 2021); three studies did not report sufficient information on participant recruitment (Peters et al., 2021; Poulsen et al., 2007; Sidhu and An, 2019); in two studies the data analysis was not rigorous enough (Biggs et al., 2009; de Alcantara et al., 2020), and one study did not report ethical considerations nor IRB approval (Biggs et al., 2009; de Alcantara et al., 2020).

3.2. Observational studies

The quantitative studies included in this section are characterized by the absence of intervention or researchers' influence on exposure allocation (Gilmartin-Thomas et al., 2018). The research designs identified in the revised articles were cross-sectional, cohort studies and case series (see Table 1).

3.2.1. Mental health outcomes reported across observational studies

The included observational studies (see Table 1) cover a total of eleven mental health outcomes:

Sleep problems were broadly defined as the presence of insufficient sleep duration, poor sleep quality, or excessive daytime sleepiness (Jahrami et al., 2020). n = 19 studies assessed sleep problems using validated self-report instruments such as the Karolinska Sleep Questionnaire (Anund et al., 2016; Diez et al., 2014; Härmä et al., 2002; Lee et al., 2017; Onninen et al., 2020; Onninen et al., 2021), Pittsburgh Sleep Quality Index (Diez et al., 2011; Chaiard et al., 2019; Chung and Wong, 2011), Epworth Sleep Questionnaire (Diez et al., 2014), Insomnia Severity Index (Lee et al., 20191), Scale for the Estimation of Sleep Problems (SESP) (Wagner et al., 2014), actigraph-based objective measurements (Onninen et al., 2021); and self reports developed by the authors (Bruno et al., 2013; Cunradi et al., 2019; Ihlström et al., 2017; Miller et al., 2020; Risco et al., 2013; Simões et al., 2019; Obelenis and Gedgaudienė, 2003).

Fatigue and need for recovery were defined as states of physical or mental energy depletion that prevent optimal task performance (Banks et al., 2019). n = 7 studies assessed fatigue or need for recovery using validated self-report instruments such as the Need For Recovery Scale (NFR Scale) (Machin and Hoare, 2008; Useche et al., 2017), Checklist Individual Strength (Useche et al., 2017), Fatigue Assessment Scale (FAS) (Jones et al., 2020); and self-reports developed by the authors (Alrukaibi and Koushki, 2008; Ihlström et al., 2017; Hu and Chen, 2019; Rydstedt et al., 1998).

Burnout symptoms included exhaustion (emotional and physical), depersonalization, cynicism or disengagement, and reduced sense of professional efficacy (Edú-Valsania et al., 2022). n = 7 studies assessed burnout symptoms using the Maslach Burnout Inventory (Chen. and Cunradi, 2008; Chen and Hsu, 2020; Tu et al., 2021; Wagner et al., 2014), Copenhagen Burnout inventory (Batool et al., 2022; Chung and Wong, 2011), and Oldenburg Burnout inventory (Buitendach et al., 2016).

Alcohol and substance use (n = 8 studies) were evaluated using standardized instruments such as the CAGE (Cut, Annoyed, Guilty, and Eye-Opener) Questionnaire (Cunha et al., 2016; Risco et al., 2013) Michigan Alcohol Screening Test (MAST) (Lin et al., 2003), and Alcohol Use Disorders Identification Test (AUDIT) (Lee et al., 2019), biological markers (Lin et al., 2003) or self-reports of consumption developed by the authors (Chen. and Cunradi, 2008; Ragland et al., 2000; Rydstedt et al., 1998).

Post-traumatic stress disorder was defined as the persistent presence of functional impairment symptoms such as re-experiencing, avoidance or hyperarousal as a result of exposure to a stressful event or situation of exceptionally threatening or horrific nature (ICD-11, 2022). n = 8 studies assessed PTSD using standardized instruments such as the Composite International Diagnostic Interview (CIDI) (Kim et al., 2013; 2013b, 2014) Impact of Event Scale (IES) (Doroga and Băban, 2013; Karlehagen et al., 1993; Malt et al., 1993; Yum et al., 2006), PTSD Checklist (PCL-C) (Zhou et al., 2018), and PTSD module of the Mini International Neuropsychiatric Interview (MINI) (Cothereau et al., 2004).

Panic disorder was defined as the presence of "recurrent unexpected panic attacks that are not restricted to particular stimuli or situations" (ICD-11, 2022). n = 2 studies assessed panic disorder using the CIDI (Kim et al., 2013; 2013b, 2014).

Depression included symptoms of depressed mood, decreased engagement in pleasurable activities, decreased energy levels, and disruptions in sleep or eating (ICD-11, 2022). n = 7 studies assessed depression using standardized instruments such as the Center for Epidemiologic Studies Depression Scale (CES-D) (Jo et al., 2010; Risco et al., 2013), Patient Health Questionnaire (PHQ) (Jones et al., 2020; Lee et al., 2019), CIDI (Kim et al., 2013; 2013b, 2014), and self-rating questionnaire for depression SRQ-D (Simões et al., 2019).

Anxiety was defined as the experience of "apprehensiveness or anticipation of future danger or misfortune accompanied by a feeling of worry, distress, or somatic symptoms of tension" (ICD-11, 2022). n = 3 studies assessed anxiety standardized instruments such as the Beck Anxiety Inventory (BAI) (Lee et al., 2019), Zung Anxiety Scale (Risco et al., 2013), and a self-report of state anxiety developed by authors (Wagner et al., 2014).

Psychopathology symptoms were defined as perceived disruptions in normal psychological functioning (Shevlin and Adamson, 2005). n = 10 studies assessed psychopathology symptoms using the General Heal th Questionnaire (GHQ) (Cendales et al., 2014; Cothereau et al., 2004; Gershon et al., 2021; Limosin et al., 2006; Tse et al., 2007; Tu et al., 2021; Vatshelle and Moen, 1997), SRQ (Simões et al., 2019), Crown-Crisp Experiential Index (CCEI) (Duffy and McGoldrick, 1990), and Chinese Health Questionnaire (CHQ) (Lin et al., 2003).

Psychosomatic symptoms were defined as basic physical dysfunctions (such as those of appetite, digestion, or sleep) or bodily sensations that workers perceive as worrisome or unpleasant (Kapfhammer, 2006). Two studies evaluated psychosomatic symptoms by the Physical Symptoms Inventory (PSI) (Tse et al., 2007) and self-reports developed by the authors (Rydstedt et al., 1998).

Psychological stress was defined as the degree to which individuals appraise situations in their lives as threatening or taxing (Cohen et al., 1983). n = 5 studies assessed psychological stress using the Perceived Stress Scale (PSS) (Joshi and Vaidya, 2017), observational measures (Carrère et al., 1991), and self-reports developed by the authors (Ihlström et al., 2017; Obelenis and Gedgaudienė, 2003).

Finally, two studies, one focused on suicidal ideation (Byun et al., 2016), assessed using the CIDI, and the other focused on mental health-related quality of life (Zhang et al., 2016), assessed using the 36-Item Short Form Health Survey (SF-36) mental component, were classified in the "other mental health outcomes" category.

3.2.2. Results by mental health outcome

Table 2 summarizes the included observational studies by mental health outcome, and relevant exposures for each occupational group of UPT workers. The evidence on associations between work exposures and mental health outcomes is described below. Association statistics were excluded for parsimony due to the high number of observational studies, but are available as supplementary material (see appendix 2). Throughout the literature review results, mentions of relevant UPT occupational groups appear in italics.

3.2.2.1. Sleep problems. Eleven cross-sectional studies (Anund et al., 2016; Bruno et al., 2013; Chaiard et al., 2019; Chung and Wong, 2011; Diez et al., 2011; Diez et al., 2014; Lee et al., 2017; Lee et al., 2019; Miller et al., 2020; Simões et al., 2019) and one case series (Wagner et al., 2014) in *bus drivers* associated their sleepiness (Anund et al., 2016; Diez et al., 2014; Lee et al., 2017; Miller et al., 2020), sleep quality (Bruno et al., 2013; Chaiard et al., 2019; Chung and Wong, 2011; Diez et al., 2011; Diez et al., 2014), and sleep disorders (Lee et al., 2019; Simões et al., 2019; Wagner et al., 2014) with work organization-related stressors.

Working hours-related exposures such as shift schedule (day/night/day or night shifts) (Chaiard et al., 2019), variation of starting time, short notice of shifts, split-shift (Ihlström et al., 2017), resting time along the working day (Diez et al., 2014), post-lunch and last driving periods (Lee et al., 2017), 6 or more days without rest, insufficient time to eat during breaks, and insufficient time to rest during breaks (Miller et al., 2020), were significantly and positively associated with *bus drivers*' sleep problems. However, driving hours per route, rest time during route, switching drivers during route, routes per day (Chaiard et al., 2019), day working hours, working hours per week, working over 45 h per week, over running of routes, late running of buses, commute time, type of work shifts (morning/afternoon and fixed vs rotating) (Miller et al., 2020), morning, evening and night working hours (Miller et al., 2020; Risco et al., 2013) and split shift working hours (Anund et al., 2016; Miller et al., 2020), were not significantly associated with sleep outcomes. The studies by Anund et al. (2016) and Miller et al. (2020) were inconsistent on the associations of more than 10 h overtime (significant in Anund et al., 2016; and null in Miller et al., 2020) and less than 11 h rest (significant in Miller et al., 2020; and null in Anund et al., 2016) with sleep problems.

Additionally, two cross-sectional studies (Chung and Wong, 2011; Lee et al., 2019) and one case series (Wagner et al., 2014) suggested that effort (workload and work pace category), rewards (career development, status and pay category), safety culture (organizational culture category) (Chung and Wong, 2011), work-home balance (Lee et al., 2019), and surface-acting (job content

category) (Wagner et al., 2014) were significantly associated with sleep problems among *bus drivers*.

Regarding physical exposures, one study reported significant positive associations between the absence of rest areas and sitting places during breaks with *bus drivers*' sleepiness (Miller et al., 2020); and one study reported null associations between noise exposures and *bus drivers*' sleep quality (Bruno et al., 2013).

With respect to *rail workers,* one cross-sectional study on *tram drivers* found that the reduced sleepiness following a rest break was less pronounced during evening shifts (Onninen et al., 2020). Furthermore, the cohort study by Härmä et al. (2002) found that among both *train drivers* and *controllers* shift length, night, and morning shifts are associated with an increased risk of sleepiness. However, this latest study also found a null association between rest time before shifts and sleepiness.

On the other hand, one cross-sectional study in *transit workers* found that time to unwind (working hours category) and job stressors (job content category), but not shift schedule and hours worked the past 7 days (working hours category), were significantly associated with sleep problems (Curandi et al., 2019).

Finally, three cross-sectional comparative studies reported that sleepiness prevalence was higher in *bus drivers* than in auto-rickshaw drivers (Risco et al., 2013); drowsiness at work was more frequent in *bus drivers* than in autolocksmiths, joiner's shop workers, electromechanics, and other UPT workers; sleep problems were more frequent in joiner's shop workers than in *bus drivers*, autolocksmiths, electromechanics, and other UPT workers (Obelenis and Gedgaudienė, 2003); and drowsy driving was higher in *professional drivers* than in non-professionals (Asaoka et al., 2012). This latest study also found that there were no significant differences between *professional* and non-professional drivers in diagnosed sleep disorders and subjective daytime sleepiness. Finally, one cohort study reported that the risk for sleepiness is higher in *tram drivers* than in truck drivers during morning shifts, but not during day and evening shifts (Onninen et al., 2021).

3.2.2.2. Fatigue and need for recovery. Five cross-sectional studies (Alrukaibi and Koushki, 2008; Hu and Chen, 2019; Machin and Hoare, 2008; Useche et al., 2017) and one cohort study (Rydstedt et al., 1998) on *bus drivers* associated fatigue with work organization-related stressors. Alrukaibi and Koushki (2008) found that working days (working hours category) and overtime shifts per week (working hours category) were positively and significantly associated with *bus drivers*' fatigue. Hu and Chen (2019) found that work related factors (a summary measure of working hours, career development, status and pay) and dealing with elder passengers (job content category) were positively associated with physical and mental fatigue; and mixed traffic flow (job content category) was positively associated with physical, but not mental fatigue. Machin and Hoare (2008) and Rydstedt et al. (1998) found that workload (workload and work pace category) was positively associated with *bus drivers*' need for recovery and spillover of fatigue from work to leisure respectively. Useche et al. (2017) found that job strain (job content, workload and work pace, and participation and control categories), social support (interpersonal relationships category), but not Effort-Reward Imbalance (workload and work pace and career development, status and pay categories), were significantly associated with both general fatigue and need for recovery. Finally, Ihlström et al. (2017) found a null association between split-shifts and *bus drivers*' persistent fatigue.

Additionally, Jones et al. (2020) found that breakroom quality (air, vibration, maintenance) (physical risk category) and usage time (working hours category) were not significantly associated with reduced fatigue in *train drivers*.

3.2.2.3. Burnout symptoms. Six cross-sectional studies in *bus drivers* (Chung and Wong, 2011; Batool et al., 2022; Buitendach et al., 2016; Chen and Hsu, 2020; Chung and Wu, 2013; Tu et al., 2021), and one in transit workers (Chen & Cunradi, 2008) associated burnout symptoms with psychosocial risk factors.

Chung and Wong (2011), Batool et al. (2021) and Chung and Wu (2013) found positive associations between Effort-Reward Imbalance (career development, status and pay category and participation and control category) and burnout syndrome among bus drivers. Chung and Wong (2011) and Batool et al. (2022) also found a negative association between safety culture (organizational culture category) and burnout; and a positive association between bad bus ergonomics and burnout. Additionally, one study in *bus drivers* (Buitendach, et al., 2016) found significant associations of job demands (workload and work pace) and resources (job content category) with burnout.

Chen and Hsu (2020) found significant associations of role overload (workload and work pace category), work-family conflict (home-work Interface category) and driver-passenger communicative stress (interpersonal relationships category), but not of supervisory support (interpersonal relationships category), with *bus drivers*' emotional exhaustion. Tu et al. (2021) also found a positive association of bus driver-passenger communicative stress (interpersonal relationships category) with cynicism. Additionally, one longitudinal case series study (Wagner et al., 2014) found that surface acting positively predicts emotional exhaustion, and has an indirect effect on *bus drivers*' emotional exhaustion and insomnia via state anxiety.

Finally, Chen and Cunradi (2008) reported a positive association of job hassle stress (job content category) with emotional exhaustion among *transit workers*.

3.2.2.4. Alcohol and substance use. Two cross-sectional studies (Cunha et al., 2016; Lee et al., 2019) and one cohort study (Rydstedt et al., 1998) on *bus drivers* associated alcohol abuse with psychosocial work stressors. Cross-sectional studies found that work-life balance (home-work interface category) is negatively associated (Lee et al., 2019) and aggressions at work (interpersonal relationships category) positively associated (Cunha et al., 2016) with alcohol abuse among *bus drivers*. However, the study by Cunha et al. (2016) reported null associations of alcohol consumption with working hours stressors (alternation of working hours, overtime and working during holidays), job content stressors (perception of traffic), occupational safety risks (personal security threatened at work and traffic crashes during the preceding 12 months), and physical risks (vibration, uncomfortable temperature, inadequate lighting,

internal and external noise). Likewise, the cohort study by Rydstedt et al. (1998) found a null association between workload and *bus drivers*' consumption of pharmacological substances.

Three cross-sectional studies on *transit workers* associated work organization-related stressors with alcohol (Ragland et al., 1995, 2000) and substance use (Chen and Cunradi, 2008). Ragland et al. (1995, 2000) found that job stress (a summary measure of workload, interpersonal relationships, working hours, job content, organizational culture, and occupational safety risks) was associated with an increased risk of alcohol problems (heavy drinking). In their 1994 study, Ragland et al. found a significant positive association between job stressors and drinks per week. However, in their 2000 study, this association was not significant. Ragland et al. (1995) also found null associations between job content/workload and work pace stressors (job demands and decision latitude) and alcohol consumption (heavy drinking and drinks per week). Additionally, Chen & Cunradi (2008) found that job hassle stress (interpersonal relationships category) was indirectly associated (via burnout and disengage-deny coping strategy) to substance use among *bus drivers*.

Finally, two comparative studies found that *bus drivers* have a lower risk of alcohol abuse than self-employed drivers (Lin et al., 2003), and auto-rickshaw drivers (Risco et al., 2013), and a lower risk of drug taking behavior than self-employed drivers (Lin et al., 2003). However, non-significant differences between *bus* and self-employed drivers were found for urinary amphetamine in the study by Lin et al. (2003).

3.2.2.5. Post-traumatic stress disorder (PTSD). Three cross-sectional studies on *subway drivers* (Kim et al., 2013; 2013b, 2014), two cross-sectional (Doroga and Băban, 2013; Malt et al., 1993) and two cohort studies (Cothereau et al., 2004; Karlehagen et al., 1993) in *train drivers*, and a case series in *bus drivers* (Zhou et al., 2018) associated PTSD symptoms with occupational safety risks.

The main risk for *subway* and *train drivers* is the exposure to suicides on the railway tracks or "Person Under Train" (PUT) incidents. Regarding subway drivers, personal (Kim et al., 2013; 2013b, 2014) and colleagues' (Kim et al., 2014) experience of PUT incidents, the number of PUT incidents (Kim et al., 2013b; 2014), when PUT was experienced and severity of PUT victim's injury (Kim et al., 2013b) significantly increased the risk of PTSD symptoms. Conflict with passengers, sudden stops from an emergency bell, and near safety incidents, but not the experience of a breakdown (Kim et al., 2014), significantly predicted subway drivers' PTSD risk.

For the case of *train workers*, two cohort studies found that drivers exposed to PUT experiences (Cothereau et al., 2004) and more than 1 week PUT-related sick-leave (Karlehagen et al., 1993) are respectively at increased risk of PTSD and avoidance/intrusion symptoms. One cross-sectional study (Malt et al., 1993) found a null association and one (Yum et al., 2006) a significant positive association between PUT exposure and avoidance/intrusion symptoms; and another cross-sectional study (Doroga and Băban, 2013) found that *train drivers* exposed to just one or two PUT incidents reported significantly more posttraumatic symptoms than *train drivers* with more PUT experiences.

Regarding other UPT occupations, only one case series in *bus drivers* (Zhou et al., 2018) found that PTSD symptoms were significantly greater 4 weeks after exposure to a violent event at work, compared to 2 weeks, 6 months, and 1 year after the event (an overall decrease in symptoms was reported over time). Additionally, the authors reported that men were more likely to experience moderate PTSD than women one month after the traumatic event. No other significant gender differences were found.

3.2.2.6. Panic disorders. Three cross-sectional studies on *subway drivers* associated occupational safety risks and psychosocial stressors with panic disorder. Kim et al. (2013, 2013b) found that *subway drivers* who experienced PUT had significantly higher lifetime and 1-year risks for panic disorder. There is also evidence that when PUT was experienced, number of PUT experiences, and severity of victim's injury are associated with greater risks of 1-year and lifetime panic disorder (Kim et al., 2013b). Kim et al. (2014) found that PUT experience of a colleague significantly increased the risk for 1-year and lifetime panic disorder; but they also found null associations of number of PUT experiences, conflict with passengers (interpersonal relationships category), near safety incidents, experienced a sudden stop, and experienced a breakdown with 1-year and lifetime risks of panic disorders.

3.2.2.7. Depression. There were a total of ten included studies dealing with the association between psychosocial stressors and depression. While six of them (Jo et al.., 2010; Jones et al., 2020; Kim et al., 2013; 2013b, and 2014; Samerei et al., 2020) focused on *rail workers* (i.e., *rail, subway* and *train drivers*), four studies (Chung and Wong, 2011; Risco et al., 2013; Lee et al., 2019; Simões et al., 2019) used samples of *bus drivers* (i.e., bus and auto rickshaw operators). Overall, all these studies found positive and significant associations between their work-related stressors and depressive symptoms.

Particularly, *bus drivers*' depression has been negatively associated with work-life balance (home-work interface) in Lee et al. (2019); and positively associated with effort-reward imbalance (workload and work pace, and career development, status and pay categories) (Chung and Wong, 2011), and job precariousness (Simões et al., 2019).

Regarding *subway/train drivers*, occupational safety risks, such as the experience of PUT incidents (Kim et al., 2013, 2013b, 2014), conflict with passengers, sudden stop from an emergency bell, near safety incidents (Jo et al., 2010), and perceived risk of suffering emergency situations (Samerei et al., 2020) are positively associated with depression.

Finally, the study by Jones et al. (2020) found that the perception of workplace health promotion actions significantly reduced odds ratios for depression among rail operators.

3.2.2.8. Anxiety. Three cross-sectional studies in *bus drivers* associated work organization-related stressors with anxiety. Lee et al. (2019) found that Work–life balance (home-work interface category) was negatively and significantly associated with anxiety; Wagner et al. (2014) found that daily surface acting (job content category) was significantly and positively associated with anxiety; found a null association between occupation (bus vs auto-rickshaw drivers) and anxiety prevalence.

3.2.2.9. Psychopathology symptoms. Eleven studies associated psychosocial risk factors with psychopathology symptoms. Eight of those studies were cross-sectional (Cendales et al., 2014; Duffy and McGoldrick, 1990; Gershon et al., 2021; Lin et al., 2003; Lopes-Simoes et al., 2019; Tse et al., 2007; Tu et al., 2021; Vatshelle and Moen, 1997) and two were cohort studies (Cothereau et al., 2004; Limosin et al., 2006).

Cendales et al. (2014) found that job strain and effort/reward imbalance (workload and work pace, and career development, status and pay categories), but not social support (interpersonal relationships category), are significantly and positively associated with *bus drivers*' psychopathology symptoms. Tse et al. (2007) and found that effort (workload and work pace category), and rewards (career development, status and pay category) are negatively associated with *bus drivers*' psychopathology symptoms; but also that adverse road conditions and passenger behavior (job content category), and poor management support (interpersonal relationships category) are not significantly associated with psychopathology symptoms. Tu et al. (2021) found a significant association between bus driver-passenger communicative stress and psychopathology.

Additionally, Lopes-Simoes et al. (2019) found that self assessed *bus drivers*' work precariousness was positively associated with increased risk of common mental disorders; Duffy and McGoldrick (1990) found that practical job problems (Job content; workload and work pace; occupational safety risk; role in the organization) were positively associated with psychoneurotic symptomatology among *bus drivers*; Gershon et al. (2021) found that difficulty accessing face shield/goggles was associated with increased risk of mental health symptoms among *transit workers* before and after NYC "COVID-19 Pause"; and Lin et al. (2003) found that self-employed drivers have significantly higher non-psychotic neurotic symptoms in comparison with *bus drivers*.

On the other hand, two cohort studies (Cothereau et al., 2004; Limosin et al., 2006) found that PUT events were significantly associated with increased risk for psychopathology symptoms among train drivers. Likewise, a cross-sectional study (Vatshelle and Moen, 1997) found that *train drivers* having experienced distressing on-the-track events reported significantly greater psychopathology symptoms than those not experiencing such events.

3.2.2.10. Psychosomatic symptoms. Two studies on *bus drivers* associated psychosocial stressors with somatic health symptoms. The cohort study by Rydstedt et al. (1998) found that workload (workload and work pace category) is positively and significantly associated with psychosomatic complaints. However, gender, and the interaction of gender and workload were not significant predictors of psychosomatic complaints (Rydstedt et al., 1998). On the other hand, the cross-sectional study by Tse et al. (2007) found that rewards (career development, status and category), but not effort (workload and work pace category), were significantly associated with somatic health symptoms. Furthermore, in an analysis that discriminated between specific *bus drivers*' effort-related stressors, Tse et al. (2007) found null associations between adverse road conditions/passenger behavior and somatic health symptoms; and between poor management support and somatic health symptoms.

3.2.2.11. Psychological stress. Three cross-sectional studies on *bus drivers* associated perceived psychological stress with psychosocial stressors. Carrère et al. (1991) found that non-verbal stress behaviors during driving and occupational stress were significantly higher among bus drivers with high job strain (job content, workload and work pace, and participation and control categories). Meanwhile, Ihlström et al. (2017) found a null association between shift type (split shift vs. non-split shift: Working hours category) and perceived stress.

The comparative study by Joshi and Vaidya (2017) found that perceived stress was significantly higher in *bus drivers* than in office staff workers. Additionally, a cross-sectional study on transit workers found that an over 8 h workday duration (working hours category) was related to psychological stress at work (Obelenis and Gedgaudienė, 2003).

3.2.2.12. Other mental health outcomes. A cross-sectional study comparing *subway workers, train drivers* and *conductors* (Zhang et al., 2016) found that both night and long work schedules (working hours category) were negatively associated with mental health-related quality of life (MHRQL) among these occupational groups. Working in both day and night shifts (working hours category) was negatively associated with MHRQL only among *train drivers*. Overall, *subway workers* and *conductors* reported significantly higher MHRQL than *train drivers*.

On the other hand, a cross-sectional study on *subway drivers* (Byun et al., 2016) found that low job control (participation and control category) and rewards (career development, status and pay category) were associated with an increased risk of suicidal ideation. However, job demands (workload and work pace category), job insecurity (career development, status and pay category), interpersonal conflict, conflict with passengers (interpersonal relationships category), occupational climate (organizational culture category), physical environment, and sudden stops due to the emergency bell were not significantly associated with *subway drivers*' suicidal ideation.

3.3. Experimental studies

The studies summarized in this section involve the deliberate manipulation of exposure for research purposes. Interventions differed from field experiments mainly because in the latter the research environment is the same one in which the subjects naturally undertake their work tasks (Levitt and John, 2009). Meanwhile, interventions, which involve planned activities with the primary intention of improving the working conditions and/or the health of the workers (Kristensen, 2005), were implemented in different clinical and organizational contexts (see Table 4).

3.3.1. Mental health outcomes reported across field experiments

The included experiments examined three mental health outcomes associated to working hours related stressors:

Fatigue and need for recovery (n = 5 studies), assessed using validated self-report instruments, such as the Samn–Perelli Fatigue Checklist (SPFC) (Jay et al., 2008), the Pearson Buyars Fatigue Feeling Checklist (PBFFC) (Milosevic, 1997), the visual analogue fatigue scale (Iridiastadi, 2021), or physiological measures such as heart rate variability (Huang et al., 2019).

Sleep problems (n = 4 studies), assessed using a validated self-report instrument, the Karolinska Sleepiness Scale (KSS) or the Karolinska Drowsiness Score (KDS) (Anund et al., 2018; Brandenburger et al., 2021; Ingre et al., 2004; Iridiastadi, 2021).

Psychosomatic symptoms (n = 1 study) assessed tension, depression and vigor from the Profile of Mood States (POMS) (Sun et al., 2018).

3.3.2. Results by mental health outcome

Table 3 summarizes the included experimental studies by mental health outcome, and relevant exposures for each occupational group of UPT workers. Associations are described below.

3.3.2.1. Fatigue and need for recovery. Three studies found increases in fatigue over driving shifts. Among 9 Australian *train drivers*, two different shift/recovery schedules were compared. In schedule 1, significant increases in fatigue compared to the pre-trip baseline were seen for all five shifts' post-shift ratings. Ratings on the three recovery days did not differ significantly from the pre-trip value. For schedule 2, ratings following shifts 2 and 4 were significantly greater than the pre-trip baseline. Ratings on recovery day 3 were significantly less. Overall, analyses showed elevated fatigue at the end of each shift. Designated 8 h rest periods appeared sufficient to reduce fatigue to levels recorded prior to departure and prevent accumulation of fatigue across the trip (Jay et al., 2008).

Among 24 Serbian *bus drivers*, subjective fatigue increased significantly after driving (t = nr, p=<0.01). However, among 7 Serbian bus drivers, the overall linear trend of heart rate decreased over a work shift (Milosevic, 1997).

Differences in fatigue between day, night and morning shifts were observed among 6 *train drivers* in Shanghai, China. During the day shift, the level of fatigue and workload were low. During the night shift, the driver's workload was continuously increasing ($F = 2.001$, $p = 0.0452 < 0.05$), and there is a high workload and driver fatigue during the passenger flow peak period of the night shift and at the end of the shift. In the morning shift, the driver's workload and fatigue are relatively high ($F = 2.712$, $p = 0.0295 < 0.05$) (Huang et al., 2019).

Likewise, An Indonesian study (Iridiastadi, 2021) found that *train conductors* (n = 16) assigned to the afternoon shift (13:00–19:30 p.m.) reported significantly more fatigue and sleepiness than those (n = 16) assigned to the morning shift (06:00–12:30).

3.3.2.2. Sleep problems. Sleepiness (KSS) among 13 German *train drivers* using partially automated equipment increased to a greater extent over 2 h of simulated driving compared to 19 drivers using fully automated equipment ($F = 5.368$; $p < 0.028$), suggesting use of higher levels of automation to tackle fatigue issues associated with train driving (Brandenburger et al., 2021).

Two Swedish studies found an increase in sleepiness due to "split shifts". 18 professional Swedish *bus drivers* drove on two afternoons; one on a day in which they had driven early in the morning (split shift) and one on a day when they had been off duty until the test (afternoon shift). 5 of the 18 drivers reached levels of severe sleepiness (KSS≥8) with an average increase in KSS of 1.94 when driving in the afternoon after working a morning shift compared with being off duty in the morning. Mean drowsiness (KDS) was significantly higher ($F = 5.114$, $p = 0.025$) on the split shift day ($M = 0.648$; $SD = 0.101$) than the afternoon shift day ($M = 0.463$; $SD = 0.101$). KDS max showed a similar effect (Anund et al., 2018).

Among 17 Swedish *train drivers* working a total of 9 h with a 2.5 h break in the middle, sleep length was reduced ($p < 0.001$) by 1 h and 2 h, respectively, in the early shift compared to the day and evening shifts. There was an increased risk for severe sleepiness (KSS) during the early shift (OR = 3.735, 95% CI: 2.205–6.329; $p < 0.001$) and evening shift (OR = 2.374; CI: 1.377–4.090; $p < 0.002$) compared to the day shift (Ingre et al., 2004).

3.3.2.3. Psychosomatic symptoms. In a field experiment with a sample of *bus drivers*, for different consecutive driving times, significantly higher tension was found in the 3–4 h range ($F = 2.646$, $p = 0.049$) than in shorter driving times (1 h, 1–2 h, 2–3 h). There were no significant differences between driving times in depressed mood (Sun et al., 2018).

3.4. Intervention studies

The studies in this section examined mental health outcomes of work redesign interventions (i.e. planned changes in the content and organization of work tasks, activities, relationships, and responsibilities. Parker, 2014; Evans et al., 1999; Poulsen et al., 2007; Zhong et al., 2021), psychotherapeutic interventions (mainly cognitive behavioral therapy), and pharmacological treatments in train drivers (Mehnert et al., 2012), and transit workers (Bender et al., 2016; Lowinger and Rombom, 2012).

3.4.1. Mental health outcomes across intervention studies

The included intervention studies (see Table 4) examined various mental health outcomes of psychotherapeutic interventions in train drivers (Mehnert et al., 2012), and transit workers (Bender et al., 2016; Lowinger and Rombom, 2012); and work redesign interventions in bus drivers (Evans et al., 1999; Poulsen et al., 2007; Zhong et al., 2021).

Post-Traumatic Stress Disorder (PTSD) was assessed using standardized instruments such as the Modified PTSD Symptom Scale (M-

PSS) (Bender et al., 2016), PCL-C (Lowinger and Rombom, 2012), and Posttraumatic Diagnostic Scale (PDS) (Mehnert et al., 2012). The study by Mehnert et al. (2012) also evaluated anxiety/depression (Hospital Anxiety and Depression Scale -HADS), psychological distress (Distress Thermometer), and health-related quality of life (SF-36) as PTSD-related outcomes. Additionally, the experience of a traumatic event at work, the barriers and motivating factors for seeking mental health treatment were qualitatively examined through semi-structured interviews in the intervention study by Bance et al.

Perceived stress and related symptoms were addressed in two of the intervention studies, both of them among urban bus drivers (Evans et al., 1999; Poulsen et al., 2007). Evans et al. (1999) measured perceived stress using a standardized scale (stress-energy questionnaire), while Poulsen et al. (2007) used authors-developed scales to measure somatic stress, cognitive stress and reduced vitality.

Lastly, *depression* (measured by the PHQ) was the focus in one study likewise conducted among bus drivers (Zhong et al., 2021).

3.4.2. Results by mental health outcome

3.4.2.1. PTSD interventions. All of the interventions in this group (PTSD) focused on individual treatment. Two out of the four intervention studies addressing PTSD prevention and recovery by implementing a "Best Practice Intervention" (BPI) as an alternative to "Treatment As Usual" (TAU) conducted among *transit workers* in Toronto, Canada. The first one was based on interviews analyzed qualitatively to understand the barriers and motivating factors for seeking specialized mental health treatment. Its sample size was 29 (11 intervention participants and 18 controls) and included 33% and 54% women in the comparison and intervention groups respectively. Emotional responses following the trauma – such as guilt, anger and disbelief – were particularly difficult. They were among the barriers to seeking help, along with the overwhelming amount and timing of paperwork related to the incident, and the negative interactions with management. On the other hand, motivating factors to seek help included family and peer support, as well as financial and emotional concerns that persuaded some of the participants in the intervention to seek specialized mental health treatment.

The second study (Bender et al., 2016) had a sample size of 141 *transit workers*: 79 intervention participants and 62 controls. The study was quasi-experimental. It focused on differences in rates at Return To Work (RTW) of work lost days and PTSD symptoms measured by the M-PSS. There were no statistically significant differences in change over time in M-PSS scores between TAU (estimated marginal means (SE) = 48.89 (3.92); 34.78 (3.95), and 25.08 (3.95), at 1, 3, and 6 months, respectively), and BPI (estimated marginal means (SE) = 53.69 (3.51), 36.58 (3.64), and 23.54 (3.68 at 1, 3, and 6 months, respectively) ($p = 0.347$). However, both groups experienced significant statistical decrease in PTSD symptoms over time ($p < 0.001$). The BPI put in practice in these studies consisted in psycho-education, screening for symptoms, referral to specialized mental health services (including Cognitive Behavioral Therapy (CBT) and/or pharmacological treatment), occupational therapy, physiotherapy, consulting psychiatric care and specialized return-to-work strategies.

Another study addressing PTSD was conducted among *transit workers* in New York, USA (Lowinger and Rombom, 2012). Its sample size of 96 included 29 per cent female workers. The intervention was compared within the single group at pre-, middle and post-session assessments. The measures of comparison were based on: the Global Assessment of Functioning (GAF), PCL-C, BAI, the Beck Depression Inventory (BDI-II); health status; and level of functioning.

The intervention treatment was based on CBT, including relaxation training, self-instructional skills, desensitization training and behavioral assignments. Improvement in nine out of the ten symptoms from the first to last treatment session; the only symptom not showing any statistically significant improvement was fatigue. The largest treatment gains in order of the partial eta-squared were for the symptoms of flashbacks ($F = 29.09$, $p = 00.00$, $n2 = 0.63$), sleep problems ($F = 37.65$, $p = 00.00$, $n2 = 0.44$), and concentration difficulty ($F = 10.03$, $p = 00.00$, $n2 = 0.38$). Moreover, eight of the ten symptoms showed significant improvement from the first session to the middle of treatment; only distress and disability failed to show significant improvement. There was also significant improvement in six of the ten symptoms: flashbacks, depression, distress, disability, and sleep problems from the middle session to the last session; however, symptoms of fear, hypervigilance, avoidance, and concentration difficulty failed to show additional significant improvement from the middle to last sessions.

The last of the four studies addressing PTSD treatment intervention (Mehnert et al., 2012) was conducted in Germany among *train drivers* exposed to suicides or emergency situations (n = 51, all men). Participants were assessed at the beginning, at the end and six months after the rehabilitation program by a battery of validated self-report questionnaires, including: PDS, HADS and SF-36.

The intervention was a four-week rehabilitation program that included education, exercises and physical therapy to regain physical fitness, relaxation training, psychosocial counseling, and cognitive-behavioral group therapy, as well as individual cognitive-behavioral interventions and resource-oriented recreational activities. Significant main effect for intervention on posttraumatic stress ($F = 9.4$, $df = 1$, $p = 00.003$), anxiety ($F = 8.1$, $df = 1$, $p = 00.007$), depression ($F = 4$, $df = 1$, $p = 00.05$), psychological distress ($F = 4.3$, $df = 1$, $p = 00.04$) and mental QoL ($F = 11.9$, $df = 1$, $p = 00.001$). No significant effect of the intervention was found on physical QoL ($F = 4.3$, $df = 1$, $p = 00.04$). No significant interaction effects were found either on posttraumatic stress ($F = 0.3$, $df = 1$, $p = 00.06$), anxiety ($F = 1.3$, $df = 1$, $p = 00.25$), depression ($F = 2.3$, $df = 1$, $p = 00.14$), psychological distress ($F = 0.5$, $df = 1$, $p = 00.49$), mental QoL ($F = 1.0$, $df = 1$, $p = 00.33$), and physical QoL ($F = 3.2$, $df = 1$, $p = 00.08$).

3.4.2.2. Depression interventions. The study by Zhong et al. (2021) among *bus drivers* (n = 86, one female worker) assessed depression (PHQ) on a single group prior to, during, and post-nutrition change program. The intervention consisted in including an extra serving of fresh fruit like an apple or a banana, in addition to a typical lunch box with no fruit included. The analyses showed a significant main

effect for food impact, F (2, 77) = 3.73, p = 0.028, partial η2 = 0.09. *Bus drivers* reported significantly decreased depression levels 1 week after the experiments ended (M 1.42, SE 0.40) compared with 1 week before it began (M 1.55, SE 0.46), p = 0.021. No significant difference was detected between before the experiment and in the middle of experiment weeks (M 1.52, SE 0.51), p = 0.387, nor between after the experiment and in the middle of experiment weeks, p = 0.124.

3.4.2.3. Stress and stress symptoms interventions. A complex intervention was conducted in Sweden (Evans et al., 1999) among a group of 41 *bus drivers*, of which ten participated in the intervention and 31 in the control group. Perceived stress, blood pressure and heart rate were assessed as direct and mediated effects of the intervention.

The intervention tackled "job hassles" along the route by introducing 15 specific changes, including in the roadway and technological innovations controlling traffic management and passenger information systems. These were monitored by an independent observer. Differences between groups for direct and mediating effects show that intervention reduced occupational stress. Positive for systolic BP; heart rate and perceived stress. No changes showed for diastolic BP.

The last study was a participatory action intervention conducted among municipal *bus drivers* (n = 2677) in Denmark (Poulsen et al., 2007) including 14 per cent female workers. Self-assessed measures of stress as developed by the authors were applied pre- and post-intervention. Illnesses and symptoms were compared with the Danish Work Environment Cohort Study (n = 5377).

A different combination of work-redesign interventions was conducted in seven garages/groups. Those changes were in the categories of working hours, resources, social support and influence at work (participation and control). The coordination of activities, participation of managers and union leaders, and the management of intervention barriers and facilitators was addressed from an action research-based approach. At the follow-up survey, the risks of self-assessed stress (OR = 0.63, CI: [0.53–0.74]), somatic stress (OR = 0.69, CI: [0.62–0.76]), cognitive stress (OR = 0.65, CI: [0.58–0.72]) and reduced vitality (OR = 0.70, CI: [0.64–0.77]) were significantly reduced from baseline. Other results from external evaluators are related to positive behavioral/healthier changes and increased cooperation and interest among parties.

3.5. Qualitative studies

Of eleven included qualitative studies (see Table 5), five investigated *bus drivers* (de Alcantara et al., 2019, 2020; Maynard et al., 2021; Pilkington-Cheney et al., 2020; Poulsen et al., 2007; Sidhu and An, 2019). Four studies investigated mixed occupational groups of *transit workers*, which in addition to bus drivers included *trainers, assessors*, and *customer service consultants* (Biggs et al., 2009); *subway drivers*, *maintenance* and *cleaning staff* (Bowles et al., 2017); *managers* (Maynard et al., 2021), and u*nion leaders* (Peters et al., 2021). One study focused on *train drivers* (Naweed et al., 2017), and another study on *bus traffic controllers* (Maynard et al., 2021). All studies used individual or group interviews-based designs, except for Poulsen et al. (2007), who used observational methods. Regarding qualitative data analysis techniques, seven studies used thematic analysis (Biggs et al., 2009; Maynard et al., 2021; Maynard et al., 2022; Naweed et al., 2017; Pilkington-Cheney et al., 2020; Peters et al., 2021; Sidhu and An, 2019), two phenomenological analysis (de Alcantara et al., 2019, 2020), one grounded theory (Bowles et al., 2017), and another discourse and dilemma analyses (Poulsen et al., 2007).

3.5.1. Data synthesis

Following thematic synthesis method, two reviewers (SD and CB) independently coded the eleven included articles. Subsequently, the generated free codes were grouped into 22 descriptive themes. The latter were discussed by the entire research team, reaching consensus on four final analytical themes: mental health experiences, work organization, personal safety concerns, and traffic (see Appendix 3).

3.5.1.1. Mental health experiences. Work-related stress (de Alcantara et al., 2019; 2020; Naweed et al., 2017; Sidhu and An, 2019), fatigue/sleepiness (Biggs et al., 2009; Bowles et al., 2017; Pilkington-Cheney et al., 2020; Maynard et al., 2021; Maynard et al., 2022; Peters et al., 2021), and anxiety (de Alcantara et al., 2019; 2020; Naweed et al., 2017) are the most salient characteristics of UPT workers' mental health experiences, due to their intensity and constant presence during work.

First, from the perspective of *bus and train drivers*, fatigue is described as an impairment of ability and alertness, commonly accompanied by boredom, irritability and withdrawn behavior (Maynard et al., 2021). UPT workers also report that work schedules and accumulated fatigue hinder detachment from work and effective recovery during rest periods (Bowles et al., 2017; Maynard et al., 2021; Pilkington-Cheney et al., 2020).

The study by Pilkington-Cheney et al. (2020) found that *bus drivers* report diverse individual fatigue-management strategies, including the use of coffee, sugar, water, fresh air, stretching, talking, and napping. However, these on-duty fatigue countermeasures depend on shift rostering, the availability of facilities such as bathrooms and rest areas, and safety restrictions on eating/drinking in the bus cabin. Support from management and union members was also discussed as an important factor in mitigating fatigue (Biggs et al., 2009), increasing the likelihood of seeking mental health treatment, and promoting health and well-being initiatives (Naweed et al., 2017). However, it was not always easy to receive support. The magnitude of paperwork and negative interactions with management were seen as a deterrent.

The reviewed qualitative studies consistently report that UPT workers are highly aware of their fatigue problems and of fatigue-related occupational safety risks, especially falling asleep while driving (Maynard et al., 2021; Pilkington-Cheney et al., 2020). In addition, they associate fatigue with health problems such as eating disorders, sleep disorders, and cardiovascular diseases (Peters

et al., 2021). However, few workers are willing to report their fatigue problems, mainly recurrent on-duty sleepiness, due to the perceived risk of disciplinary consequences (Maynard et al., 2021; Maynard et al., 2022).

Second, both *bus* (Sidhu and An, 2019; de Alcantara et al., 2019, 2020) and *train drivers* (Naweed et al., 2017) report high levels of psychophysiological activation described by themselves as stress responses to environmental factors typical of urban public transport. In particular, shift rostering problems (Naweed et al., 2017; Sidhu and An, 2019), communication with organizational leaders (Naweed et al., 2017), the incivility of public transport users (Sidhu and An, 2019; de Alcantara et al., 2019, 2020) and heavy traffic (de Alcantara et al., 2019, 2020) are perceived as overwhelming demands due to their intensity, chronic presence and unpredictability. Furthermore, these stressors are perceived as unavoidable and to this extent, stress is understood by UPT workers as an inseparable experience from work; as well as the ability to resist stress is understood as an essential individual trait to preserve health and work performance (de Alcantara et al., 2019; 2020; Naweed et al., 2017; Sidhu and An, 2019).

And third, *bus and train drivers* report experiences of anxiety, described as anticipatory states of apprehension and worried thoughts associated with the repeated presence of unpredictable environmental threats (de Alcantara et al., 2019; 2020; Naweed et al., 2017). For example, de Alcantara et al. (2020, 2121) found that *bus drivers* define their work environment as a "box full of surprises", in which anything can happen at any time. This perception mainly refers to traffic incidents and violent behavior of passengers, which represent threats to the personal safety of UPT workers. Likewise, based on the perspective of *train drivers*, Naweed et al. (2017) found that anxiety experiences arise mainly from the contradiction between the strict timeframes to get from station to station, or "timetable pressure", and the obligation to adhere to job requirements, especially speed limits and stopping patterns.

3.5.1.2. Work organization. Overall, work organization was discussed as a contributing factor to the mental health experiences, particularly overall stress, and fatigue levels. Working hours was a commonly discussed factor among *bus drivers* and *transit workers*, that included the frequency and distribution of shift patterns (Maynard et al., 2021; Peters et al., 2021), length of turnaround periods between shifts (Biggs et al., 2009), amount of overtime hours (Maynard et al., 2021.), high number of continuous days worked (Biggs et al., 2009), and shortened breaks (Bowles et al., 2017). Working hours were perceived to be contributing to sleep debt, circadian rhythm issues, persistent low level tiredness (Naweed et al., 2017), performance issues, and resorting to the consumption of caffeinated beverages and unhealthy food choices (Bowles et al., 2017). Split shifts were seen as having benefits for some, such as being able to eat without being rushed, and drawbacks for most, such as increasing the total time spent away from home (Sidhu and An, 2019). Overall, these findings highlight the importance of addressing driver fatigue and providing drivers with sufficient rest periods and predictable schedules to maintain their health and ensure safe driving practices.

Biggs et al. (2009) discussed how *bus drivers* had unrealistically tight route schedules and restricted shift breaks that contributed significantly to their fatigue levels. Additionally, drivers often found the practice of issuing tickets, handling cash, checking concessions, and validating passes at every stop cognitively draining (Biggs et al., 2009). One study showed differences in job demands and compensation between small and large bus drivers at the same workplace (Peters et al., 2021). *Bus and subway drivers* discussed the high level of responsibility they must ensure passenger safety (Maynard et al., 2021; Bowles et al., 2017). However, despite this perceived high level of responsibility, they also lacked autonomy and control over their workday (Bowles et al., 2017). Drivers in this study noted that productivity expectations had increased, leading to increased performance pressure and impacting their well-being (Bowles et al., 2017).

Time pressure was perceived as an important cause of *bus drivers*' mental health problems (Poulsen et al., 2007; Naweed et al., 2017). Naweed et al. (2017) found that pressure came from two sources: self-inferred pressure, which refers to the pressure that drivers feel to come into work, and pressure experienced from others, especially traffic controllers and supervisors. Limited organizational resources in remote work locations lead to pressure on the drivers to cover those shifts. The authors also found that time pressure was amplified in day-to-day communication, as drivers were constantly reminded to stick to timetables, adhere to railway regulations, and to avoid making mistakes. These reminders are often also posted in driver mess halls and notice boards (Naweed et al., 2017).

Management was perceived by *transit workers* as being controlling, inflexible, and unsupportive (Bowles et al., 2017; Peters et al., 2021), and it was suggested that having personal connections with members in the union was necessary to receive organizational support (Bowles et al., 2017). Trade unions saw the sources of health problems being in the working environment, where management saw it in the workers' lifestyles (Poulsen, et al., 2007). In a study by Bowles et al. (2017), participants described a community in fear of making mistakes, due to the organizational culture that was created through sanctions. A "lack of community" was described as having four sub-categories: lack of respect, inadequate communication, formation of small networks or cliques, and prevailing self interest (Bowles et al., 2017). Communication issues within organizations were identified as a significant barrier to adopting a healthy lifestyle by participants (Naweed et al., 2017).

Bus drivers identified several cabin ergonomic factors that impacted their fatigue levels, including improperly adjusted seats from previous driver, and a difficulty of setting it up for themselves before their shift (Peters et al., 2021), inadequate control over the temperature in the cabin, exposure to heat and glare from the windshield, exposure to noise, exposure to passengers and potential violence, and pain in the neck, back, and shoulder (Biggs et al., 2009). They also discussed issues with poor quality radio communications (Maynard et al., 2021). A lack of available facilities was a problem for drivers (Pilkington-Cheney et al., 2020) and discussed as a limiting factor in getting proper rest and recovery and contributing to fatigue (Maynard et al., 2021).

Highlighted in work life balance was the difficulties of *transit workers* in maintaining healthy sleep patterns and eating habits, as well as finding time for social engagements, especially for individuals working rotating shifts (Bowles et al., 2017). *Bus and subway drivers* also faced barriers to adapting positive health behaviors, separating work from home life, and often lacked recovery time due to the demanding nature of their job (Bowles et al., 2017). Sedentary exposure and the inability to maintain physical fitness were also

identified as key concerns (Naweed et al., 2017). Drivers had limited opportunities to use vacation time, and in some cases, it could be canceled on short notice due to the scheduling needs of their supervisors (Peters et al., 2021). Drivers discussed how the interest in overtime can be disruptive, as employers can contact them at home, potentially interrupting their sleeping patterns (Maynard et al., 2021). Long commutes added to their time spent away from home and drivers discussed as adding to their fatigue (Biggs et al., 2009; Maynard et al., 2021).

3.5.1.3. Personal safety concerns. Workers in the transport industry presented mixed perceptions of personal risk at work. Carcinogens (Bowles et al., 2017) and electromagnetic radiation in the cab (Naweed et al., 2017), concerned some workers. In one study, there was concern about opening windows due to threats of violence on bus drivers (Pilkington-Cheney et al., 2020).

While drivers reported generally having good passenger relationships, stressful interpersonal situations are frequent. Requests for directions, aggressive (verbal or physical) passenger behavior, and perceptions of passenger vigilance or driver performance were themes discussed as contributing to fatigue (Biggs et al., 2009). Passengers would make special requests of the drivers, such as turning off the cold air that was helping drivers feel awake (Peters et al., 2021).

3.5.1.4. Traffic. Traffic was discussed by bus drivers as a stressful risk vigilance demand (de Alcantara et al., 2019, 2020; Sidhu and An, 2019), being unpredictable, chaotic, and dangerous. Most perceived threats in the road environment (such as reckless maneuvers by other drivers) are sudden, but recurring, thus generating sustained anticipatory anxiety (de Alcantara et al., 2019).

Both fast and slow traffic are perceived by bus drivers as sources of stress. Slow traffic represents an impedance factor, which hinders compliance with scheduled routes and passenger expectations (Sidhu and An, 2019; de Alcantara et al., 2019, 2020). Meanwhile, in fast traffic, bus drivers are subject to stricter speed restrictions than those of light vehicles, which persistently try to get in front of them, generating risky situations (de Alcantara et al., 2019). Organizational safety regulations (such as speed limits) are also perceived as contradicting the time pressure on scheduled routes (Poulsen et al., 2007). To this extent, traffic represents a sustained and unavoidable stressor, against which there are few coping alternatives beyond emotional control (de Alcantara et al., 2019).

4. Discussion

4.1. Summary of findings

This study systematically reviewed the quantitative and qualitative evidence on the effects of occupational exposures and interventions on UPT workers' mental health. The most investigated occupations w*ere bus, train, tram and subway drivers*. Operational support personnel (e.g., *maintainers, cleaners and traffic controllers*) have been investigated mainly by studies with mixed samples of "transit workers", which do not provide specific evidence on the mental health outcomes and occupational exposures for each selected occupational group, thus preventing comparisons.

Quantitative field, experimental, and intervention studies covered a total of eleven mental health outcomes: sleep problems, fatigue and need for recovery, alcohol and substance use, PTSD, panic disorders, depression, anxiety, psychopathology symptoms, psychosomatic symptoms, and psychological stress. The two most investigated and best performing predictors of mental health outcomes were work organization-related stressors, followed by occupational safety risk factors. These last included PUT-events and crashes in railway workers, and passengers/drivers' aggressions in bus drivers. Only 4/71 quantitative studies investigated physical risk factors such as noise, temperature, and quality (absence of physical hazards)/availability of rest facilities.

Quantitative studies on work organization-related stressors focused mainly on exposures of r*ail and bus drivers* classified in the "working hours" WHO category, such as resting times, working hours/day/week, split shift hours, morning/evening/night shift hours, variation of starting time, short notice of shifts, routes per day and driving hours per route. Meanwhile, organizational stressors classified in the WHO categories of job content, workload and work pace, participation and control, interpersonal relationships, career development, status and pay, were mainly investigated from the perspectives of Job Demands-Control, Job Demands-Resources and Effort-Rewards Imbalance models of stress. Little research has investigated organizational culture and home-work interface-related stressors among UPT workers.

Regarding the associations between occupational exposures and specific mental health outcomes, it was found that job content, workload and work pace, participation and control, interpersonal relationships, career development, status and pay-related stressors are key predictors of sleep problems, fatigue and need for recovery, burnout symptoms, alcohol and substances use, depression, psychosomatic symptoms, and psychological stress among UPT workers. Likewise, occupational safety risk factors are the main factors associated with PTSD, panic disorder, depression, alcohol and substance use, and psychopathology symptoms among *rail and bus drivers*.

Longitudinal and experimental evidence consistently suggests that working hours-related stressors are significantly associated with sleep disorders and fatigue. However, the cross-sectional evidence on the effect of working hours-stressors on sleep problems, fatigue and need for recovery, alcohol and substance use is inconsistent. This is probably due to methodological bias in the included cross-sectional studies, and frequent differences in self-reports of exposures (for example, some studies evaluate split-shift as a Y/N dichotomous variable, others as total split-shift hours, and still others as split-shifts during the week).

The few studies on physical risk factors of UPT workers reported null associations between mental health outcomes and exposures such as vibration, uncomfortable temperature, inadequate lighting, noise and lack of or inadequate rest facilities. All these studies are cross-sectional, based on self-reports of exposures and of low methodological quality, especially due to participants' selection bias.

Regarding intervention studies, most of the included articles focus on managing PTSD symptoms of UPT workers exposed to occupational safety risk factors such as PUT-events, violence and traffic crashes, from a psychotherapeutic perspective. The reviewed evidence suggests that CBT-based treatments and multicomponent programs (combinations of CBT, psycho-education, screening for symptoms, pharmacological treatment, occupational therapy, physiotherapy, psychiatric care and specialized return-to-work strategies) are effective in reducing symptoms of PTSD, which tend to disappear in periods of between six months and a year in treated patients.

An individual intervention focused on nutritional changes (fruit intake at lunch during three weeks) proved effective in improving *bus drivers*' depression symptoms. Furthermore, interventions focused on work redesign (working hours, social support, participation and control, and traffic management) and technological support (and passenger information systems) proved effective in reducing bus drivers' stress symptoms.

Finally, the qualitative evidence was found to be highly consistent with the quantitative findings. The main contributions of qualitative studies are, first, the detailed in-depth description of stress, fatigue, and anxiety experiences of UPT workers, which stand out for their intensity and perceived inevitability. The qualitative characterization of stress experiences also includes an exploration of contradictions in work organization typical of professional driving, such as high demands for operational agility (time pressure), combined with organizational restrictions on speed, heavy traffic conditions, and passenger service needs. Second, the qualitative literature contributes to the identification of individual fatigue and sleepiness countermeasures, such as the use of coffee, sugar, water, fresh air, stretching, talking, and napping; and perceived barriers to the use of these countermeasures, mainly the lack of availability of rest facilities and time pressure. And third, qualitative studies report a lack of trust in organizational and union leaders, who are not perceived by UPT workers as relevant sources of social support for mental health protection.

4.2. Review in the context of previous studies

The results of this study are consistent with previous literature reviews on physical and mental health outcomes among *bus drivers*. Such studies suggest that this occupational group is at high risk for cardiovascular, musculoskeletal (Kompier and Di Martino, 1995; Ragland et al., 1998; Tse et al., 2006), gastrointestinal (Kompier and Di Martino, 1995; Tse et al., 2006), and respiratory disease (Ragland et al., 1998), psychological stress, fatigue, sleep disorders (Evans, 1994; Kompier and Di Martino, 1995; Tse et al., 2006), anxiety, depression, PTSD (Tse et al., 2006), alcohol and substance use (Ragland et al., 1998; Tse et al., 2006). In addition to confirming these previous findings, this review found evidence suggesting that *bus drivers* are also at risk of burnout and psychosomatic symptoms, which are mental health outcomes little investigated among UPT workers.

Likewise, consistently with previous reviews on *bus drivers*, this study confirmed that work organization-related stressors, such as high demands (especially time pressure), and low resources (low job control, social support, promotion opportunities, status and pay) (Evans, 1994; Kompier & Di Martino, 1995; Ragland et al., 1998; Tse et al., 2006); and safety risks, such as passenger violence and road aggressions (Kompier and Di Martino, 1995; Ragland et al., 1998; Tse et al., 2006), are the work exposures most consistently associated with negative mental health outcomes among this occupational group. Of course, organizational stressors (Häusser et al., 2010; Stansfeld and Candy, 2006; Tsutsumi and Kawakami, 2004) and violence at work (Nyberg et al., 2021) are also widely documented predictors of mental health outcomes in the general working population.

Unlike previous literature reviews (Evans, 1994; Kompier and Di Martino, 1995; Tse et al., 2006), this study found that the cross-sectional evidence on the association between *bus drivers*' working hours-related stressors and mental health outcomes is highly inconsistent. It is possible that this discrepancy is due to the fact that the use of quasi-systematic approaches makes previous reviews vulnerable to reporting and selection bias. From the findings of this review, it is clear that more studies with high methodological quality and standardized measures of shift work are needed to reach consensus on the mental health outcomes of key bus driver exposures such as split shifts, long shifts, and rotating shifts.

Previous literature reviews have also found higher physical health-related mortality, morbidity, and absenteeism in *bus drivers* compared to other blue-collar workers. However, this review found that, compared to self-employed drivers, f*ormal bus and rail drivers* report lower risk of negative mental health outcomes, such as alcohol and substance use, psychopathology, and fatigue symptoms. These findings are in line with the evidence on informal transport work precariousness, which represents a growing road safety and public health issue in low- and middle-income countries (Agbiboa, 2016; Soliani and Bueno, 2022).

Regarding *railway workers*, two previous reviews found that subway and train drivers report high prevalence of PTSD, anxiety, and depression associated with exposure to PUT-events (Clarner et al., 2015; Carey et al., 2021). The present study is consistent with these findings and adds to previous reviews that panic disorder is also a relevant outcome of witnessing railway suicides. The results of this study are also in line with the evidence on the effectiveness of trauma-focused cognitive-behavioral therapy, which has been used successfully to improve return-to-work time and work functioning of railway workers exposed to PUT-evens (Torchalla and Strehlau, 2018).

Unlike occupational trauma-focused programs, the evidence on the effectiveness of work redesign programs in public transport has not been previously reviewed. With only two studies included in this review focused on organizational changes associated with positive mental health outcomes, the evidence base on work redesign programs in the UPT industry remains limited. However, abundant studies in the general working population suggest that changes in adverse working conditions (e.g., flexible work and scheduling changes; job and task modifications; relational and team dynamic initiatives; and participatory process interventions) are the most promising approach to improve workers' well-being (Fox et al., 2021) and performance (Knight and Parker, 2021).

4.3. Practical implications

The recently published WHO guidelines on mental health at work (World Health Organization, 2022a, 2022b), and WHO-ILO policy brief (WHO-ILO, 2022) recommend that strategies to address mental health at work should cover three areas of action: 1. Prevent workers from experiencing mental health issues through removing work exposures; 2. Protect and promote mental health at work through individual interventions; and 3. Support workers with mental health conditions through rehabilitation, return-to-work and supported employment initiatives. Consistently with WHO-ILO guidelines, the results of this review suggest that interventions focused on the mental health of UPT workers should prioritize the management of work organization-related stressors and occupational safety risks, mainly from the perspective of work redesign. The most urgent changes should address working hours, workload, and work pace-related stressors, looking for work designs that reduce time pressure and promote effective recovery during rest periods. Unfortunately, there are few documented examples of interventions with this approach. The programs "Human Side of the Road" (Rydstedt et al., 1998; Evans et al., 1999) and "Healthy Bus Project" (Poulsen et al., 2007), both implemented more than 20 years ago in northern Europe, remain to date the most prominent efforts to improve UPT workers' health through changes in work organization. The results of both programs suggest that traffic management (e.g., dedicated bus lanes and elimination of bottlenecks), improvement of passenger access (e.g., user-friendly stations for drivers), improved information systems for drivers (e.g., in-vehicle information systems) and passengers (e.g., arrival/departures displays), reorganization of shifts, on-duty rest times, and bus fleet renewal/maintenance, represent effective actions to prevent stress-related disease.

Interventions focused on job redesign remain scarce in UPT systems, probably because although the elimination of psychosocial exposures has been shown to be effective in reducing stress-related negative health outcomes, there is no evidence on its cost-effectiveness. This research gap needs to be investigated, considering the high human and road/occupational safety costs associated with worker health problems in the transport industry (Gurubhagavatula et al., 2020). However, there is evidence of job-redesign interventions in the general working population with high economic viability, which are potentially replicable in UPT workers. For instance, in their literature review, Bambra et al. (2008) found that changes in shift work, such as switching from slow to fast rotation, from backward to forward rotation, and shift self-scheduling, may positively affect workers' health at very low direct costs or even at no cost to organizations.

Interventions focused on occupational safety risks of UPT workers are also needed, mainly violence in bus systems, and PUT-events in rail systems. Regarding violence on public transport, political actions and law enforcement are needed to deter attacks against workers (Zhou et al., 2018). For example, during the last decade, 30 USA states have tightened laws against violent behavior in transport, increasing fines and penalties against offenders (ATU, 2012). UPT workers' unions have also proposed using physical barriers (e.g., bus cabin separation panels) and surveillance devices (e.g., cameras and emergency call buttons) to protect workers at high risk of violence such as bus drivers, and educational interventions focused on promoting civic behavior in public transport (UITF-ITF Joint Statement: Recommendations for Combating Violence and Insecurity on Urban Public Transport, 2015). For the specific case of rail workers, reviews on the effectiveness of PUT prevention programs suggest that measures focused on distancing victims from the railway tracks, such as suicide pits, and the use of blue lights in stations, which have a potentially calming effect on agitated people, significantly decrease suicide frequency inside railway stations (Barker et al., 2017).

Regarding individual health WHO-ILO area of action, there is also evidence that health promotion actions with an individual approach focused on the development of healthy lifestyle habits (Zhong et al., 2021), communication skills and conflict resolution in UPT workers (Poulsen et al., 2007) can reinforce the positive mental health outcomes generated by structural changes in work organization. However, in an occupational group highly exposed to environmental stressors such as UPT workers, it is crucial not to displace responsibility for health from working conditions and place it on people.

Finally, regarding the rehabilitation and return to work WHO-ILO area of action, all interventions found in UPT workers focus on recovery from PTSD and PTSD related depression, anxiety and panic disorders. This evidence base suggests that therapeutic interventions based on trauma-focused cognitive-behavioral therapy (e.g., exposure therapy and cognitive processing therapy, eye movement desensitization and reprocessing, cognitive therapy, and stress inoculation training) reduce PTSD symptoms and facilitate return to work in both victims of violence and witnesses of PUT-events (Torchalla and Strehlau, 2018).

From the qualitative evidence reviewed, participatory action represents one of the most promising intervention alternatives. In particular, the involvement of organizational leaders and labor unions are key contextual factors for the effectiveness of mental health interventions. To do this, it is necessary to overcome trust barriers, stigma and administrative obstacles such as excessive paperwork, which prevent timely reporting of mental health problems, participation in organizational interventions, and even discussion of mental health problems among co-workers (Poulsen et al., 2007). Both organizations and unions can also play a key role in negotiating with government authorities to achieve improvements in transport infrastructure and employment conditions for UPT workers, which have deteriorated since the covid-19 pandemic, especially in low and middle income countries (ITF, 2023).

4.4. Research gaps and emerging issues in literature

Regarding mental health outcomes, this study found that burnout and suicidal behaviors have been little investigated in UPT workers. Investigating burnout in this occupational group is crucial because this syndrome is one of the most documented outcomes of work-organization related stressors in the general working populations (Aronsson et al., 2017). Knowing that UPT workers are highly exposed to psychosocial work stressors, it is most likely that they are also at high risk of burnout. In addition, knowledge about burnout among UPT workers may contribute to explain related health outcomes, such as fatigue, sleep disorders, depression, anxiety, gastrointestinal issues, and cardiovascular disease (Koutsimani et al., 2019; Salvagioni et al., 2017), which are highly prevalent in this

occupational group.

Similarly, suicide can be an outcome of adverse working conditions (Howard et al., 2022), and also of work stress-related mental health issues documented in UPT workers, such as anxiety (Bentley et al., 2016), depression (Hawton et al., 2013) and alcohol use (Norström and Rossow, 2016). In addition, deaths by suicide are a growing problem in the working population. In the USA alone, it is estimated that suicidal behaviors represent, in addition to the loss of lives, organizational costs of 93.5 billion dollars, associated with health expenses and reduced productivity (Shepard et al., 2016).

With regard to occupational exposures potentially predictive of mental health outcomes, the results of this review suggest five research lines. First, studies are needed on UPT workers other than urban drivers, mainly operational support personnel such as conductors, cleaners, station agents, maintenance workers, and ticket sellers. These occupations may have specific occupational hazards that remain understudied, but also share urban bus driver's exposures such as time pressure and passenger incivility, documented by this and previous reviews as predictors of negative mental health outcomes (Evans, 1994; Kompier & Di Martino, 1995; Tse et al., 2006).

Comparative evidence focused on gender and ethnicity in the transportation industry also remains very scarce. In most countries, occupations in public transport such as drivers and maintainers, which are the most researched, are still male-dominated, which means that most study groups are by default male. In addition, there is still a tendency among researchers to omit the sex distribution of occupational groups and report a "homogeneous composition", leaving out the different forms of employment, as well as job and health practices by gender. In this review, only in two cases (Rydstedt et al., 1998; Zhou et al., 2018), one with null results (Rydstedt et al., 1998), researchers compared work related-mental health outcomes by gender, without more profound reflections on the differential experiences and working conditions of men and women.

Likewise, in the research field there are no cross-cultural comparisons focused on health or working conditions, nor on experiences in mental health associated with workers' ethnicity. This last issue is crucial because blue-collar immigrant employees are a group at risk for work-related mental health problems (Shirmohammadi et al., 2023), and the migrant population represents more than 20% of the workforce in the USA and Europe (ILO, 2019). This research line may also broaden the evidence base to compare the exposures and health outcomes of different occupational groups in the public transport industry.

Secondly, although work-organization related stressors are the most documented predictors of UPT workers' mental health, the evidence is concentrated on job content, workload and work pace, working hours, participation and control, career development, status and pay, and interpersonal relationships issues. Very few studies have investigated relevant exposures related to the home-work interface, employees' role in the organization, and organizational culture. Work-home interactions are relevant in the UPT industry because shift work and time pressure are associated with work-family conflict (Arlinghaus et al., 2019), which in turn is a consistent predictor of stress-related health outcomes (Allen et al., 2000). Likewise, although responsibility for people is a documented role stressor in human service providers, it has been little studied in UPT workers. And finally, the reviewed qualitative evidence suggests that UPT workers report frequent organizational culture-related stressors, such as low interpersonal trust, leadership, and poor communication with organization managers and union representatives, but these exposures and their association with mental health outcomes have not yet been quantified.

Third, there is also a critical need for standardized operationalizations of working hours-related stressors, including shift types, duration, and rotation. This need exists not only in studies on UPT workers, but also in the general research field on the association between shift work and health outcomes (Zhao et al., 2019). The standardization of these measures could notably contribute to the methodological quality of self-report based studies, as well as to the evidence comparability and the consensus on the health outcomes of shift work in UPT workers, and among other occupational groups.

Fourth, very few studies have associated physical work exposures with UPT workers' mental health. Consistently with the results of this review, studies in the general population had found that the evidence on the association between major pollutants (including air, noise and light pollution) and mental health is inconclusive (Buoli et al., 2018; Ventriglio et al., 2021). However, this is an emerging research field, in which UPT worker exposures such as road traffic noise and lights represent promising research targets.

Finally, similar to previous literature reviews on the UPT workers' occupational exposures (Evans, 1994; Kompier and Di Martino, 1995; Ragland et al., 1998; Tse et al., 2006), this study found that the lack of evidence-based intervention studies is one of the main gaps in the research field. As mentioned, preventive efforts focused on job redesign are especially urgent, and are likely to be more successful than individual-focused interventions.

4.5. Strengths & limitations

To the best of our knowledge, this is the first study to review the quantitative and qualitative evidence on the effects of occupational exposures and interventions on UPT workers' mental health. The PRISMA guidelines and standardized synthesis methods were used to guarantee the results' rigor and reproducibility, thus overcoming the methodological quality of previous thematically close reviews. Although the evidence reviewed remains limited mainly to UPT drivers, this study also synthesized evidence on subway, train, and tram workers, and even on understudied UPT workers, such as traffic controllers.

However, the results of this study are limited by issues in the reviewed literature that should be noted. The quantitative studies' methodological heterogeneity forced the use of narrative synthesis methods, which, unlike meta-analytic calculations, are vulnerable to interpretation bias. Mixed methodological quality problems were also found, mainly selection bias within field studies; and weak control of variables in the experimental studies. Additionally, considering that most of the evidence on the association between occupational exposures and UPT workers' mental health comes from cross-sectional studies, caution is recommended in attributing causation based on the results of this review.

Regarding the limitations of this study, it should be noted that the reported findings are restricted to the time span, language, search engines and search terms predefined for the review. In addition, gray literature was excluded and, as in all literature reviews, potentially eligible new studies may have been published after the dates on which the systematic search was conducted.

5. Conclusion

The evidence base about the effects of occupational exposures on the UPT workers' mental health suggests that work organization-related stressors, such as workload, time pressures, shift work, and unbalanced job designs (e.g. high demands and low control, and high effort and low rewards) significantly increase the risk of sleep disorders, fatigue/sleepiness, alcohol and substance use, depression, anxiety, psychopathology symptoms, psychosomatic symptoms, and psychological stress. Safety risks such as exposure to violence in *bus drivers* and PUT-events in *railway workers* significantly increase the risk of PTSD, depression and panic disorders.

Considering the occupational exposures of UPT workers, organizational interventions focused on the removal of occupational hazards seem to be the most effective option to improve mental health in the transport industry. However, there is still a lack of evaluative research evidence surrounding effective individual and work organization changes that improve UPT workers' mental health. Research is also needed on under-investigated outcomes, such as burnout and suicidal behavior; about work organization-related stressors such as the home-work interface, and organizational culture (especially, trust and communication between co-workers and between workers, managers and union representatives); role stressors, such as dealing with transport users' problems, and responsibility for passenger safety; and physical risks potentially associated with negative mental health oucomes, such as exposures to air, noise and light pollution. The evidence base on occupational risks associated with the mental health of UPT workers can mainly benefit from high-quality longitudinal studies, laboratory and field experiments, which reveal causal relationships between exposures and outcomes.

Financial disclosure

The Authors did not receive any specific funding for this work.

CRediT authorship contribution statement

Boris E. Cendales: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Viviola Gómez-Ortiz:** Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Sergio A. Useche:** Conceptualization, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Leonor Cedillo:** Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Daryl W.H. Stephenson:** Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Paul Landsbergis:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

The authors acknowledge the support of the International Transport Workers Federation for providing a small grant to assist in conducting an earlier version of the literature review. The report containing the earlier review is titled "Essential public services, essential workers' health: union-based initiatives to protect the mental health of young public transport workers (2023)", and available on: https://www.itfglobal.org /en/news/essential-public-services-essential-workers-health-union-based-initiatives-protect-mental.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jth.2024.101804.

References

Agbiboa, D.E., 2016. 'No condition IS permanent': informal transport workers and labour precarity in africa's largest city. Int. J. Urban Reg. Res. 40 (5), 936–957.
Allen, T.D., Herst, D.E., Bruck, C.S., Sutton, M., 2000. Consequences associated with work-to-family conflict: a review and agenda for future research. J. Occup. Health Psychol. 5 (2), 278.
Alrukaibi, F.S., Koushki, P.A., 2008. Impact of fatigue on bus transit drivers. Kuwait J. Sci. Eng. 35 (1B), 1.
Amalgamated Transit Unit (ATU) Government Affairs Department, 2012. State Laws Providing for Specific Penalties in Connection with Harming Transit and School Bus Employees. Updated October 26. (Accessed 31 January 2020).
Anund, A., Fors, C., Ihlström, J., Kecklund, G., 2018. An on-road study of sleepiness in split shifts among city bus drivers. Accid. Anal. Prev. 114, 71–76.
Anund, A., Ihlström, J., Fors, C., Kecklund, G., Filtness, A., 2016. Factors associated with self-reported driver sleepiness and incidents in city bus drivers. Ind. Health 54 (4), 337–346.
Arlinghaus, A., Bohle, P., Iskra-Golec, I., Jansen, N., Jay, S., Rotenberg, L., 2019. Working Time Society consensus statements: evidence-based effects of shift work and non-standard working hours on workers, family and community. Ind. Health 57 (2), 184–200.
Aronsson, G., Theorell, T., Grape, T., Hammarström, A., Hogstedt, C., Marteinsdottir, I., et al., 2017. A systematic review including meta-analysis of work environment and burnout symptoms. BMC Publ. Health 17, 1–13.
Asaoka, S., Abe, T., Komada, Y., Inoue, Y., 2012. The factors associated with preferences for napping and drinking coffee as countermeasures for sleepiness at the wheel among Japanese drivers. Sleep Med. 13 (4), 354–361.
Bambra, C.L., Whitehead, M.M., Sowden, A.J., Akers, J., Petticrew, M.P., 2008. Shifting schedules: the health effects of reorganizing shift work. Am. J. Prev. Med. 34 (5), 427–434.
Banks, S., Landon, L.B., Dorrian, J., Waggoner, L.B., Centofanti, S.A., Roma, P.G., Van Dongen, H.P., 2019. Effects of fatigue on teams and their role in 24/7 operations. Sleep Med. Rev. 48, 101216.
Barker, E., Kolves, K., De Leo, D., 2017. Rail-suicide prevention: systematic literature review of evidence-based activities. Asia Pac. Psychiatr. 9 (3), e12246.
Batool, Z., Younis, M.W., Yasir, A., Rehman, A.U., Dilawar, M., Yasin, M., et al., 2022. Effects of safety pattern, cabin ergonomics, and sleep on work-related stress and burnout of city and transit bus drivers in Lahore, Pakistan. Ergonomics 65 (5), 704–718.
Bender, A., Eynan, R., O'Grady, J., Nisenbaum, R., Shah, R., Links, P.S., 2016. Best practice intervention for post-traumatic stress disorder among transit workers. Work 54 (1), 59–71.
Bentley, K.H., Franklin, J.C., Ribeiro, J.D., Kleiman, E.M., Fox, K.R., Nock, M.K., 2016. Anxiety and its disorders as risk factors for suicidal thoughts and behaviors: a meta-analytic review. Clin. Psychol. Rev. 43, 30–46.
Biggs, H., Dingsdag, D., Stenson, N., 2009. Fatigue factors affecting metropolitan bus drivers: a qualitative investigation. Work 32 (1), 5–10.
Boland, A., Cherry, G., Dickson, R. (Eds.), 2017. Doing a Systematic Review: A Student's Guide.
Bowles, N.P., McEwen, B.S., Boutin-Foster, C., 2017. Trouble in transit: organizational barriers to workers' health. Am. J. Ind. Med. 60 (4), 350–367.
Brandenburger, N., Naumann, A., Jipp, M., 2021. Task-induced fatigue when implementing high grades of railway automation. Cognit. Technol. Work 23, 273–283.
Bruno, P.S., Marcos, Q.R., Amanda, C., Paulo, Z.H., 2013. Annoyance evaluation and the effect of noise on the health of bus drivers. Noise Health 15 (66), 301.
Budd, L., Ison, S., 2020. Responsible Transport: a post-COVID agenda for transport policy and practice. Transp. Res. Interdiscip. Perspect. 6, 100151.
Buitendach, J.H., Bobat, S., Muzvidziwa, R.F., Kanengoni, H., 2016. Work engagement and its relationship with various dimensions of work-related well-being in the public transport industry. Psychol. Develop. Soc. 28 (1), 50–72.
Buoli, M., Grassi, S., Caldiroli, A., Carnevali, G.S., Mucci, F., Iodice, S., et al., 2018. Is there a link between air pollution and mental disorders? Environ. Int. 118, 154–168.
Byun, J., Kim, H.R., Lee, H.E., Kim, S.E., Lee, J., 2016. Factors associated with suicide ideation among subway drivers in Korea. Annals of Occupational and Environ. Med. 28 (1), 1–6.
Carey, M.G., Regehr, C., Wagner, S.L., White, M., Alden, L.E., Buys, N., et al., 2021. The prevalence of PTSD, major depression and anxiety symptoms among high-risk public transportation workers. Int. Arch. Occup. Environ. Health 94, 867–875.
Carrère, S., Evans, G.W., Palsane, M.N., Rivas, M., 1991. Job strain and occupational stress among urban public transit operators. J. Occup. Psychol. 64 (4), 305–316.
Cendales, B., Useche, S., Gomez, V., 2014. Psychosocial work factors, blood pressure and psychological strain in male bus operators. Ind. Health 52 (4), 279–288.
Chaiard, J., Deeluea, J., Suksatit, B., Songkham, W., 2019. Factors associated with sleep quality of Thai intercity bus drivers. Ind. Health 57 (5), 596–603.
Chen, C.F., Hsu, Y.C., 2020. Taking a closer look at bus driver emotional exhaustion and well-being: evidence from Taiwanese urban bus drivers. Safety and Health at Work 11 (3), 353–360.
Chen, M.J., Cunradi, C., 2008. Job stress, burnout and substance use among urban transit operators: the potential mediating role of coping behaviour. Work. Stress 22 (4), 327–340.
Chung, Y.S., Wong, J.T., 2011. Developing effective professional bus driver health programs: an investigation of self-rated health. Accid. Anal. Prev. 43 (6), 2093–2103.
Chung, Y.S., Wu, H.L., 2013. Stress, strain, and health outcomes of occupational drivers: an application of the effort reward imbalance model on Taiwanese public transport drivers. Transport. Res. F Traffic Psychol. Behav. 19, 97–107.
Clarner, A., Graessel, E., Scholz, J., Niedermeier, A., Uter, W., Drexler, H., 2015. Work-related posttraumatic stress disorder (PTSD) and other emotional diseases as consequence of traumatic events in public transportation: a systematic review. Int. Arch. Occup. Environ. Health 88 (5), 549–564.
Cohen, S., Kamarck, T., Mermelstein, R., 1983. A global measure of perceived stress. J. Health Soc. Behav. 385–396.
Cothereau, C., De Beaurepaire, C., Payan, C., Cambou, J.P., Rouillon, F., Conso, F., 2004. Professional and medical outcomes for French train drivers after "person under train" accidents: three year follow up study. Occup. Environ. Med. 61 (6), 488–494.
Critical Appraisal Skills Programme UK, 2018. CASP Checklists. Retrieved from. https://casp-uk.net/casp-tools-checklists/.
Cunha, N.O., Giatti, L., Assunção, A.Á., 2016. Factors associated with alcohol abuse and dependence among public transport workers in the metropolitan region of Belo Horizonte. Int. Arch. Occup. Environ. Health 89, 881–890.
Cunradi, C.B., Moore, R.S., Battle, R.S., 2019. Frequency of job stressors, difficulty unwinding after work, and sleep problems among urban transit operators. J. Workplace Behav. Health 34 (1), 3–19.
Dai, J., Liu, Z., Li, R., 2021. Improving the subway attraction for the post-COVID-19 era: the role of fare-free public transport policy. Transport Pol. 103, 21–30.
de Alcantara, V.C.G., Silva, R.M.R.C.A., Pereira, E.R., da Silva, D.M., Flores, I.P., 2020. Urban traffic and the stress factors perceived by bus drivers: a phenomenological Study. Enfermagem Uerj 28. NA-NA.
de Alcantara, V.C., Costa Rosa Andrade Silva, R.M., Ramos Pereira, E., Melo da Silva, D., Pinto Flores, I., 2019. The experience in traffic and its effects on the health of bus drivers: a phenomenological descriptive study. Revista de Enfermagem Referência 4 (23).
Diez, J.J., Vigo, D.E., Cardinali, D.P., Pérez-Chada, D., 2014. Sleep habits, daytime sleepiness and working conditions in short-distance bus drivers. Int. J. Workplace Health Manag. 7 (4), 202–212.
Diez, J.J., Vigo, D.E., Lloret, S.P., Rigters, S., Role, N., Cardinali, D.P., Chada, D.P., 2011. Sleep habits, alertness, cortisol levels, and cardiac autonomic activity in short-distance bus drivers: differences between morning and afternoon shifts. J. Occup. Environ. Med. 806–811.
Docherty, I., Marsden, G., Anable, J., Forth, T., 2021. Transport, the economy and environmental sustainability post-Covid-19. In: Productivity and the Pandemic. Edward Elgar Publishing.
Doroga, C., Băban, A., 2013. Traumatic exposure and posttraumatic symptoms for train drivers involved in railway incidents. Clujul Med. 86 (2), 144.
Duffy, C.A., McGoldrick, A.E., 1990. Stress and the bus driver in the UK transport industry. Work. Stress 4 (1), 17–27.
Edú-Valsania, S., Laguía, A., Moriano, J.A., 2022. Burnout: a review of theory and measurement. Int. J. Environ. Res. Publ. Health 19 (3), 1780.
Evans, G.W., 1994. Working on the hot seat: urban bus operators. Accid. Anal. Prev. 26 (2), 181–193.

Evans, G.W., Johansson, G., Rydstedt, L., 1999. Hassles on the job: a study of a job intervention with urban bus drivers. J. Organ. Behav.: Int. J. Industrial, Occupational and Org. Psychol. Behav. 20 (2), 199–208.
Fox, K.E., Johnson, S.T., Berkman, L.F., Sianoja, M., Soh, Y., Kubzansky, L.D., Kelly, E.L., 2021. Organisational-and group-level workplace interventions and their effect on multiple domains of worker well-being: a systematic review. Work & Stress 36 (1), 30–59.
Gershon, R.R., Merdjanoff, A.A., Meltzer, G.Y., Piltch-Loeb, R., Rosen, J., Nwankwo, E.M., et al., 2021. Impact of occupational exposure to COVID-19 on the physical and mental health of an essential workgroup: New York City transit workers. J. Emerg. Manag. (Weston, Mass.) 19 (9), 133.
Gilmartin-Thomas, J.F., Liew, D., Hopper, I., 2018. Observational studies and their utility for practice. Aust. Prescr. 41 (3), 82.
Golinko, V., Cheberyachko, S., Deryugin, O., Tretyak, O., Dusmatova, O., 2020. Assessment of the risks of occupational diseases of the passenger bus drivers. Safety and Health at Work 11 (4), 543–549.
Gromadzińska, J., Wąsowicz, W., 2019. Health risk in road transport workers part I. occupational exposure to chemicals, biomarkers of effect. Int. J. Occup. Med. Environ. Health 32 (3).
Gurubhagavatula, I., Tan, M., Jobanputra, A.M., 2020. OSA in professional transport operations: safety, regulatory, and economic impact. Chest 158 (5), 2172–2183.
Härmä, M., Sallinen, M., Ranta, R., Mutanen, P., Müller, K., 2002. The effect of an irregular shift system on sleepiness at work in train drivers and railway traffic controllers. J. Sleep Res. 11 (2), 141–151.
Häusser, J.A., Mojzisch, A., Niesel, M., Schulz-Hardt, S., 2010. Ten years on: a review of recent research on the Job Demand–Control (-Support) model and psychological well-being. Work. Stress 24 (1), 1–35.
Hawton, K., i Comabella, C.C., Haw, C., Saunders, K., 2013. Risk factors for suicide in individuals with depression: a systematic review. J. Affect. Disord. 147 (1–3), 17–28.
Howard, M.C., Follmer, K.B., Smith, M.B., Tucker, R.P., Van Zandt, E.C., 2022. Work and suicide: an interdisciplinary systematic literature review. J. Organ. Behav. 43 (2), 260–285.
Hu, S.R., Chen, S.Y., 2019. Effects of mixed traffic and elderly passengers on city bus drivers' work-related fatigue. Transport. Res. F Traffic Psychol. Behav. 66, 485–500.
Huang, Y.C., Li, L.P., Liu, Z.G., Zhu, H.Y., Zhu, L., 2019. Assessment of urban railway transit driver workload and fatigue under real working conditions. Transport. Res. Rec. 2673 (11), 891–900.
Ihlström, J., Kecklund, G., Anund, A., 2017. Split-shift work in relation to stress, health and psychosocial work factors among bus drivers. Work 56 (4), 531–538.
International Labour Organization, 2019. ILO Global Estimates on International Migrant Workers. https://www.ilo.org/wcmsp5/groups/public/—ed_protect/—protrav/—migrant/documents/publication/wcms_808939.pdf.
Ingre, M., Kecklund, G., Åkerstedt, T., Kecklund, L., 2004. Variation in sleepiness during early morning shifts: a mixed model approach to an experimental field study of train drivers. Chronobiol. Int. 21 (6), 973–990.
International Labour Organization -ILO, 2021. Technical meeting on the future of decent and sustainable work in urban transport services. https://www.ilo.org/wcmsp5/groups/public/—ed_dialogue/—sector/documents/meetingdocument/wcms_795523.pdf.
International Transport Workers Federation -ITF, 2023. Essential public services, essential workers' health: union-based initiatives to protect the mental health of young public transport workers. https://www.itfglobal.org/en/reports-publications/essential-public-services-essential-workers-health-briefing-paper.
Iridiastadi, H., 2021. Fatigue in the Indonesian rail industry: a study examining passenger train drivers. Appl. Ergon. 92, 103332.
Jahrami, H., Dewald-Kaufmann, J., Faris, M.E.A.I., AlAnsari, A.M., Taha, M., AlAnsari, N., 2020. Prevalence of sleep problems among medical students: a systematic review and meta-analysis. J. Publ. Health 28, 605–622.
Jay, S.M., Dawson, D., Ferguson, S.A., Lamond, N., 2008. Driver fatigue during extended rail operations. Appl. Ergon. 39 (5), 623–629.
Jo, S.J., Yim, H.W., Kim, H.R., Lee, K.S., Park, J.I., Chang, S.M., 2010. Association of subway driver's depressive symptoms and experience of work-related problems. Epidemiol. Health 32.
Jones, N.M., McDonnell, M., Sparer-Fine, E., Rosner, B., Dennerlein, J.T., Kales, S., Messerlian, C., 2020. Associations between the breakroom built environment, worker health habits, and worker health outcomes: a pilot study among public transit rail operators. J. Occup. Environ. Med. 62 (8), e398.
Joshi, A.R., Vaidya, S.M., 2017. Evaluation of perceived stress in bus drivers of Pune city. Natl. J. Physiol. Pharm. Pharmacol. 7 (1), 90.
Juster, R.P., McEwen, B.S., Lupien, S.J., 2010. Allostatic load biomarkers of chronic stress and impact on health and cognition. Neurosci. Biobehav. Rev. 35 (1), 2–16.
Kapfhammer, H.P., 2006. Somatic symptoms in depression. Dialogues Clin. Neurosci. 8 (2), 227–239.
Karlehagen, S., Malt, U.F., Hoff, H., Tibell, E., Herrstromer, U., Hildingson, K., Leymann, H., 1993. The effect of major railway accidents on the psychological health of train drivers—II. A longitudinal study of the one-year outcome after the accident. J. Psychosom. Res. 37 (8), 807–817.
Kim, H.R., Yim, H.W., Jo, S.J., Choi, B., Jeong, S.H., Lee, K.S., et al., 2013. Major depressive disorder, panic disorder, and post-traumatic stress disorder in Korean subway drivers. Int. Arch. Occup. Environ. Health 86, 471–477.
Kim, S.E., Kim, H.R., Park, J.I., Lee, H.W., Lee, J., Byun, J., Yim, H.W., 2014. The association between psychiatric disorders and work-related problems among subway drivers in Korea. Annals of Occupational and Environ. Med. 26 (1), 1–6.
Knight, C., Parker, S.K., 2021. How work redesign interventions affect performance: an evidence-based model from a systematic review. Hum. Relat. 74 (1), 69–104.
Koehl, A., 2020. Urban transport and COVID-19: challenges and prospects in low-and middle-income countries. Cities & health 1–6.
Kompier, M.A., Di Martino, V., 1995. Review of bus drivers' occupational stress and stress prevention. Stress Med. 11 (1), 253–262.
Kompier, M.A., Aust, B., van den Berg, A.M., Siegrist, J., 2000. Stress prevention in bus drivers: evaluation of 13 natural experiments. J. Occup. Health Psychol. 5 (1), 11.
Koutsimani, Panagiota, Montgomery, Anthony, Georganta, Katerina, 2019. The relationship between burnout, depression, and anxiety: a systematic review and meta-analysis. Front. Psychol. 284.
Kristensen, T.S., 2005. Education: intervention studies in occupational epidemiology. Occup. Environ. Med. 62 (3), 205–210. https://doi.org/10.1136/oem.2004.016097.
Lee, D.W., Hong, Y.C., Seo, H.Y., Cho, S.J., Nam, S.H., Park, C.J., Lee, N., 2019. Poor work–life balance may lead to impaired cognitive function in bus drivers. J. Occup. Environ. Med. 61 (10), e406–e412.
Lee, S., Kim, H.R., Byun, J., Jang, T., 2017. Sleepiness while driving and shiftwork patterns among Korean bus drivers. Annals of Occupational and Environ. Med. 29 (1), 1–8.
Leka, S., Griffiths, A., Cox, T., 2004. Protecting Workers Health Series No 3: Work Organization & Stress. World Health Organization (WHO), Geneva.
Levitt, Steven D., John, A. List, 2009. Field experiments in economics: the past, the present, and the future. Eur. Econ. Rev. 53 (1), 1–18.
Limosin, F., Loze, J.Y., Cothereau, C., De Beaurepaire, C., Payan, C., Conso, F., et al., 2006. A prospective study of the psychological effects of "person under train" incidents on drivers. J. Psychiatr. Res. 40 (8), 755–761.
Lin, S.K., Lee, C.H., Pan, C.H., Hu, W.H., 2003. Comparison of the prevalence of substance use and psychiatric disorders between government-and self-employed commercial drivers. Psychiatr. Clin. Neurosci. 57 (4), 425–431.
Lowinger, R.J., Rombom, H., 2012. The effectiveness of cognitive behavioral therapy for PTSD in New York City transit workers: a preliminary evaluation. N. Am. J. Psychol. 14 (3), 471–484.
Machin, M.A., Hoare, P.N., 2008. The role of workload and driver coping styles in predicting bus drivers' need for recovery, positive and negative affect, and physical symptoms. Hist. Philos. Logic 21 (4), 359–375.
Malt, U.F., Karlehagen, S., Hoff, H., Herrstromer, U., Hildingson, K., Tibell, E., Leymann, H., 1993. The effect of major railway accidents on the psychological health of train drivers—I. Acute psychological responses to accident. J. Psychosom. Res. 37 (8), 793–805.
Maynard, S., Filtness, A., Miller, K., Pilkington-Cheney, F., 2021. Bus driver fatigue: a qualitative study of drivers in London. Appl. Ergon. 92, 103309.
Maynard, S., Miller, K.A., Filtness, A., 2022. Keeping the service running: examining working relationships and workload of London bus network iBus controllers. Appl. Ergon. 98, 103577.

Mehnert, A., Nanninga, I., Fauth, M., Schäfer, I., 2012. Course and predictors of posttraumatic stress among male train drivers after the experience of 'person under the train'incidents. J. Psychosom. Res. 73 (3), 191–196.
Miller, K.A., Filtness, A.J., Anund, A., Maynard, S.E., Pilkington-Cheney, F., 2020. Contributory factors to sleepiness amongst London bus drivers. Transport. Res. F Traffic Psychol. Behav. 73, 415–424.
Milosevic, S., 1997. Drivers' fatigue studies. Ergonomics 40 (3), 381–389.
Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., PRISMA Group*, 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann. Intern. Med. 151 (4), 264–269.
Moskalewicz, A., Oremus, M., 2020. No clear choice between Newcastle–Ottawa Scale and Appraisal Tool for Cross-Sectional Studies to assess methodological quality in cross-sectional studies of health-related quality of life and breast cancer. J. Clin. Epidemiol. 120, 94–103.
Nakamura, S., Fukuma, K., Wada, K., Ueda, M., Hayashi, M., 2018. Intervention for regulating sleep–wake rhythms to prevent sleepiness in Japanese train drivers. Sleep Biol. Rhythm 16, 351–356.
Naweed, A., Chapman, J., Allan, M., Trigg, J., 2017. It comes with the job. J. Occup. Environ. Med. 59 (3), 264–273.
Norström, T., Rossow, I., 2016. Alcohol consumption as a risk factor for suicidal behavior: a systematic review of associations at the individual and at the population level. Arch. Suicide Res. 20 (4), 489–506.
Nyberg, A., Kecklund, G., Hanson, L.M., Rajaleid, K., 2021. Workplace violence and health in human service industries: a systematic review of prospective and longitudinal studies. Occup. Environ. Med. 78 (2), 69–81.
Obelenis, V., Gedgaudienė, D., 2003. Study on occupational and nonoccupational risk factors and health of motor transport workers. Transport 18 (4), 189–192.
Onninen, J., Hakola, T., Puttonen, S., Tolvanen, A., Virkkala, J., Sallinen, M., 2020. Sleep and sleepiness in shift-working tram drivers. Appl. Ergon. 88, 103153.
Onninen, J., Pylkkönen, M., Hakola, T., Puttonen, S., Virkkala, J., Tolvanen, A., Sallinen, M., 2021. The self-reported causes of sleepiness in shift-working tram and truck drivers. Transport. Res. F Traffic Psychol. Behav. 78, 153–163.
Pae, C.U., 2015. Why systematic review rather than narrative review? Psychiatry Investig. 12 (3), 417.
Parker, S.K., 2014. Beyond motivation: job and work design for development health ambidexterity and more. Annu. Rev. Psychol. 65, 661–691.
Peters, S.E., Grogan, H., Henderson, G.M., López Gómez, M.A., Martínez Maldonado, M., Silva Sanhueza, I., Dennerlein, J.T., 2021. Working conditions influencing drivers' safety and well-being in the transportation industry:"on board" program. Int. J. Environ. Res. Publ. Health 18 (19), 10173.
Peterson, J., Welch, V., Losos, M., Tugwell, P., 2011. The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Ottawa: Ottawa Hospital Res. Instit. 2 (1), 1–12.
Pilkington-Cheney, F., Filtness, A.J., Haslam, C., 2020. A qualitative study exploring how city bus drivers manage sleepiness and fatigue. Chronobiol. Int. 37 (9–10), 1502–1512.
Poulsen, K.B., Jensen, S.H., Bach, E., Schostak, J.F., 2007. Using action research to improve health and the work environment for 3500 municipal bus drivers. Educ. Action Res. 15 (1), 75–106.
Ragland, D.R., Greiner, B.A., KrausE, N., Holman, B.L., Fisher, J.P., 1995. Occupational and nonoccupational correlates of alcohol consumption in urban transit operators. Prev. Med. 24 (6), 634–645.
Ragland, D.R., Greiner, B.A., Yen, I.H., Fisher, J.M., 2000. Occupational stress factors and alcohol-related behavior in urban transit operators. Alcohol Clin. Exp. Res. 24 (7), 1011–1018.
Ragland, D.R., Krause, N., Greiner, B.A., Fisher, J.M., 1998. Studies of health outcomes in transit operators: policy implications of the current scientific database. J. Occup. Health Psychol. 3 (2), 172.
Risco, J., Ruiz, P., Mariños, A., Juarez, A., Ramos, M., Salmavides, F., et al., 2013. Excessive sleepiness prevalence in public transportation drivers of a developing country. Traffic Inj. Prev. 14 (2), 145–149.
Rydstedt, L.W., Johansson, G., Evans, G.W., 1998. A longitudinal study of workload, health and well-being among male and female urban bus drivers. J. Occup. Organ. Psychol. 71 (1), 35–45.
Salvagioni, D.A.J., Melanda, F.N., Mesas, A.E., González, A.D., Gabani, F.L., Andrade, S.M.D., 2017. Physical, psychological and occupational consequences of job burnout: a systematic review of prospective studies. PLoS One 12 (10), e0185781.
Samerei, S.A., Aghabayk, K., Akbarzade, M.H., 2020. Underground metro drivers: occupational problems and job satisfaction. Urban Rail Transit 6 (3), 171–184.
Shevlin, M., Adamson, G., 2005. Alternative factor models and factorial invariance of the GHQ-12: a large sample analysis using confirmatory factor analysis. Psychol. Assess. 17 (2), 231.
Shepard, D.S., Gurewich, D., Lwin, A.K., Reed Jr, G.A., Silverman, M.M., 2016. Suicide and suicidal attempts in the United States: costs and policy implications. Suicide Life-Threatening Behav. 46 (3), 352–362.
Shirmohammadi, M., Beigi, M., Richardson, J., 2023. Subjective well-being among blue-collar immigrant employees: a systematic literature review. Hum. Resour. Manag. Rev. 33 (1), 100914.
Sidhu, S., An, G., 2019. Occupational health internship program at a metropolitan transit authority: exploring split shifts as a health and safety concern for bus operators. New Solut.: J. Environ. Occupational Health Pol. 29 (2), 266–283.
Simões, M.R.L., Souza, C., Alcantara, M.A.D., Assunção, A.Á., 2019. Precarious working conditions and health of metropolitan bus drivers and conductors in Minas Gerais, Brazil. Am. J. Ind. Med. 62 (11), 996–1006.
Soliani, R., Bueno, L., 2022. Occupational health and safety in the Brazilian sector of cargo transportation: a systematic review on the category of self-employed drivers. Occupational and Environ. Safety and Health III, 613–620.
Stansfeld, S., Candy, B., 2006. Psychosocial work environment and mental health—a meta-analytic review. Scand. J. Work. Environ. Health 443–462.
Sun, X.L., Hu, Z., Shumin, F., Zhenning, L., 2018. Bus drivers' mood states and reaction abilities at high temperatures. Transport. Res. F Traffic Psychol. Behav. 59, 436–444.
Taylor, A.H., Dorn, L., 2006. Stress, fatigue, health, and risk of road traffic accidents among professional drivers: the contribution of physical inactivity. Annu. Rev. Publ. Health 27, 371–391.
Torchalla, I., Strehlau, V., 2018. The evidence base for interventions targeting individuals with work-related PTSD: a systematic review and recommendations. Behav. Modif. 42 (2), 273–303.
Tse, J.L., Flin, R., Mearns, K., 2007. Facets of job effort in bus driver health: deconstructing" effort" in the effort-reward imbalance model. J. Occup. Health Psychol. 12 (1), 48.
Tse, J.L., Flin, R., Mearns, K., 2006. Bus driver well-being review: 50 years of research. Transport. Res. F Traffic Psychol. Behav. 9 (2), 89–114.
Tsutsumi, A., Kawakami, N., 2004. A review of empirical studies on the model of effort–reward imbalance at work: reducing occupational stress by implementing a new theory. Soc. Sci. Med. 59 (11), 2335–2359.
Tu, Z., He, J., Zhou, N., Shen, X., 2021. Driver-passenger communicative stress and psychological distress among Chinese bus drivers: the mediating effect of job burnout. BMC Publ. Health 21, 1–9.
UITF-ITF Joint Statement: Recommendations for Combating Violence and Insecurity on Urban Public Transport, 2015. International Association of Public Transport (UITP) and International Transport Forum (ITF).
Useche, S.A., Ortiz, V.G., Cendales, B.E., 2017. Stress-related psychosocial factors at work, fatigue, and risky driving behavior in bus rapid transport (BRT) drivers. Accid. Anal. Prev. 104, 106–114.
Vatshelle, Å., Moen, B.E., 1997. Serious on-the-track accidents experienced by train drivers: psychological reactions and long-term health effects. J. Psychosom. Res. 42 (1), 43–52.
Ventriglio, A., Bellomo, A., di Gioia, I., Di Sabatino, D., Favale, D., De Berardis, D., Cianconi, P., 2021. Environmental pollution and mental health: a narrative review of literature. CNS Spectr. 26 (1), 51–61.
Vickerman, R., 2021. Will Covid-19 put the public back in public transport? A UK perspective. Transport Pol. 103, 95–102.
Wagner, D.T., Barnes, C.M., Scott, B.A., 2014. Driving it home: how workplace emotional labor harms employee home life. Person. Psychol. 67 (2), 487–516.

World Health Organisation, 2001. The World Health Report—Mental Health: New Understanding, New Hope. World Health Organisation, Geneva.
World Health Organization, 2022a. *ICD-11: International classification of diseases* (11th revision). https://icd.who.int/.
World Health Organization, 2022b. WHO guidelines on mental health at work. https://iris.who.int/bitstream/handle/10665/363177/9789240053052-eng.pdf?sequence=1.
WHO-ILO, 2022. Mental health at work: policy brief. https://iris.who.int/bitstream/handle/10665/362983/9789240057944-eng.pdf?sequence=1.
Yum, B.S., Roh, J.H., Ryu, J.C., Won, J.U., Kim, C.N., Lee, J.E., Kim, K.Y., 2006. Symptoms of PTSD according to individual and work environment characteristics of Korean railroad drivers with experience of person-under-train accidents. J. Psychosom. Res. 61 (5), 691–697.
Zhang, X., Chen, G., Xu, F., Zhou, K., Zhuang, G., 2016. Health-related quality of life and associated factors of frontline railway workers: a cross-sectional survey in the Ankang Area, Shaanxi Province, China. Int. J. Environ. Res. Publ. Health 13 (12), 1192.
Zhao, Y., Richardson, A., Poyser, C., Butterworth, P., Strazdins, L., Leach, L.S., 2019. Shift work and mental health: a systematic review and meta-analysis. Int. Arch. Occup. Environ. Health 92, 763–793.
Zhong, B., Wang, X., Yang, F., 2021. More than an apple: better lunch enhances bus drivers' work performance and well-being. Int. J. Occup. Saf. Ergon. 27 (3), 874–883.
Zhou, B., Boyer, R., Guay, S., 2018. Dangers on the road: a longitudinal examination of passenger-initiated violence against bus drivers. Stress Health 34 (2), 253–265.