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The Sense of Coherence and Mental Health Among First Responders: a scoping review and critical analysis of causation

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Abstract

Introduction: Public safety personnel (PSP) experience three to five times higher rates of occupational stress injuries and adverse mental health outcomes. Sense of coherence (SOC) is a psychological trait that reflects coping capacity to deal with stressors, shown to act as a protective factor against adverse mental health outcomes.

Methods: This review was conducted using the five-stage scoping review framework to answer two questions: 1) what is the extent, nature, and quality of research that has investigated the SOC and PSP mental health, and 2) what is the current state of the causal inference between SOC and post-traumatic stress symptoms (PTSS) and how does this guide next steps for research. Articles were identified through seven databases, "grey" literature, and hand-searching. Publication details, methodology, participant information, and results were extracted and summarized using descriptive statistics. A quality and causal analysis were performed using the Quality in Prognostic Studies tool and Bradford Hill Criteria for causation.

Results: Eleven articles were included in this review. The publication years ranged from 2000 to 2020, 91% of the articles originated from the European Union, and 64% had a medium to high risk-of-bias. The PSP population of interest included police officers, firefighters, and paramedics. Most studies (73%) used a cross-sectional design to assess the relationship between SOC and PTSS. All studies reported that lower PTSS were low to moderately associated with higher SOC scores ($r = -0.17$ to -0.47, $p < 0.05$ to 0.001 and $\beta = -0.31$, $p = 0.009$). There was insufficient research to support a causal relationship between the SOC and PTSS, as the literature did not support several criteria (i.e., strength, consistency, temporality, and experimental evidence).

Conclusions: While SOC evidence is preliminary, associations are sufficient to warrant future longitudinal and interventional studies.

Take-home message: Literature on SOC and PSP mental health is sparse and homogeneous. Low to moderate associations were found that SOC may act as a protective factor for mental health ***outco-***

mes; the causality between SOC and PTSS is preliminary, with limited support. Future research should focus on longitudinal and interventional study designs.

Key words: Sense of coherence, post-traumatic stress disorder, occupational stress disorder, first responder, public safety personnel.

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INTRODUCTION

First responders or public safety personnel (PSP) are people who work on the frontlines to ensure the safety and security of others, including but not limited to firefighters, paramedics, police officers, and correctional workers [1]. PSP have unique job requirements where they are often exposed to workplace critical incidents (CIs). A workplace CI can be described as a sudden and overwhelming traumatic event that "exceed beyond an individual's normal coping skills and may ultimately lead to adverse mental health consequences" [2, 3]. For example, common CI exposures are self-inflicted trauma, incidents with multiple casualties, and serious injury or death to children [3]. The majority (84%) of PSP report experiencing one or more CIs on the job; notably, this number varies based on the profession and has been observed to be as high as 96.4% in firefighters [3, 4]. Due to the stressful nature of the job and exposure to CIs PSP are viewed as a high-risk population for developing occupational stress injuries, such as post-traumatic stress disorder (PTSD) and anxiety disorders.

Various studies in the literature have assessed the prevalence of occupational stress injuries among PSP; however, the results of these studies vary considerably. For example, the lifetime prevalence of PTSD among firefighters ranged from 6.4% to 57% and ranged from 0% to 44% among police officers [5, 6]. The pooled prevalence of PTSD among PSP was found to be 14.6% in ambulance personnel, 7.3% in firefighters, and 4.7% in police officers [7]. In comparison, the prevalence of PTSD in the general population is 1.3% to 3.5% [2]. A 2018 systematic review on mental health among ambulance personnel reported the prevalence of depression, anxiety, and general psychological distress to be 15%, 15%, and 27% respectively [8]. While a 2017 study among Saudi firefighters reported that the prevalence of anxiety and depression was 44.4% and 53.3% among their sample [9]. Comparatively, the lifetime prevalence of major depressive disorder and anxiety disorders in the general population is 11.3% and 5% [2].

In 1979, Aaron Antonovsky introduced the concept of salutogenesis. This theory describes how people try to manage the chaos of everyday life by finding coping strategies with their available resources [10]. Antonovsky highlights the sense of coherence (SOC) as a key component in the salutogenic model, which can describe someone's ability to adapt to and overcome stressors. The SOC may also predict someone's movement toward a state of health or disease depending on their ability to cope with stressors. As described in Antonovsky's 1979 *Health, Stress, and Coping*, it is hypothesized that people's life experiences (i.e., social, cultural, and historical), also referred to as generalized resistance resources, shape their SOC. Antonovsky defined generalized resistance resources as a physical, biochemical, artifactual-material, cognitive, emotional, valuative-attitudinal, interpersonal-relational, or macro sociocultural characteristic that effectively avoids or combats stressors [11]. For example, someone with supportive interpersonal relationships may manage stress more easily due to this support and will have a stronger SOC.

The SOC is comprised of three main elements: comprehensibility (i.e., understanding why a stressful event occurred), manageability (i.e., being able to manage the stressful event and fallout), and meaningfulness (i.e., ability to find meaning in the stressful event) [11]. The theory proposes that someone with a strong SOC (i.e., comprehensibility, manageability, and meaningfulness) will be able to adapt to and recover from stressful events, and they will move toward a positive state of

mental and physical health [11]. Alternatively, people who have a weak SOC and are unable to manage a stressful event will move toward disease (mental and/or physical) [12, 13]. For example, when someone experiences an adverse/stressful life event, they are faced with the opportunity to adapt, cope, and recover from this event. If this happens, it will strengthen their SOC, which will allow them to overcome adverse events more easily and efficiently in the future, as they have developed coping strategies from this experience, and they will move toward a state of health.

PSP occupational demands require them to respond to and diffuse highly stressful situations, which places a high demand on their mental ability to cope and adapt. If this mental stress load imposed by occupational demands is too much and one cannot cope or adapt, they may experience chronic stress and mental exhaustion as a result [12, 13]. When someone experiences chronic stress and mental exhaustion, they become vulnerable to additional adverse mental and physical health conditions [12, 13]. Current literature shows that PSP have three to five times higher rates of occupational stress injuries and have elevated rates of PTSD, depression, and anxiety compared to the general population [2]. This data suggest that PSP may have difficulty coping and adapting to the high mental demands of the occupation, and that there is a need to identify resources to help PSP adapt to and recover from these stressful events. The SOC has been hypothesized to mediate the effect of stress and foster resiliency in stressful situations [14]. The SOC is an understudied psychological trait that has gained momentum in the research community over the last five years. The SOC has shown promising results that it may act as a protective factor against adverse mental health outcomes in populations with high occupational stress demands [15-17]. For example, a 2020 systematic review on SOC and mental health found that SOC was a protective factor for depressive symptoms and burnout among female nurses [17].

Based on the above definition and explanation of SOC, some may argue that SOC has theoretical and empirical overlap with other commonly studied psychological traits, such as resiliency. Currently, there is a debate within the literature concerning the similarity or distinctiveness of the two definitions [18]. The concept of resiliency has been studied for decades and has become a pillar for many mental health training programs among PSP. As the concept of resiliency has become increasingly popular over recent years and within the PSP population, mental health training programs have shifted to be marketed as "resiliency training/building programs," suggesting that these mental health programs are built around a central component: resiliency. There is no doubt that the concept of resiliency is an imperative trait to have among PSP whose jobs require continuous exposure to high stress and critical incidents. However, the concept of resiliency, despite its popularity, "lacks consensus on the definition, conceptualization, and measurement" within the scientific community [19, 20]. This raises concerns about the theoretical methodology that these programs are based on. The SOC is understudied; however, it has a comprehensive definition with several validated measurements and encompasses the same overall goal of resiliency, the ability to overcome a stressful event/experience [21]. As such, the SOC was chosen as the concept of interest in this review, with the intent that this review will inform future research and, in turn, definitions and mental health program methodology and adaptations.

Objectives

There is unclear and limited research on the SOC as it relates to PSP mental health, specifically, whether there is evidence to show that the SOC may be used to mediate adverse mental health outcomes among PSP. For that reason, a scoping review was conducted to systematically map existing literature to better understand the relationship between the SOC and PSP mental health, summarize and disseminate findings, and identify gaps and future research targets in this body of literature. This study will focus on three specific PSP groups, firefighters, paramedics, and police officers, due to their job similarities and, by proxy, stress exposure similarities. This scoping review answers two questions: 1) what is the extent, nature, and quality of research that has investigated the SOC and PSP mental health, and 2) what is the current state of the causal inference between SOC and post-traumatic stress symptoms (PTSS) and how does this guide next steps for research.

METHODS

This study was performed using a scoping review design as proposed by Arksey and O'Malley (2005) and further refined by Levac and colleagues (2010) and Peters and colleagues (2020) [22, 23]. A scoping review is an exploratory study that systematically maps existing literature on a particular

topic that has unclear and limited research, with the aim of identifying key concepts, theories, and gaps in the literature [24]. A scoping review was chosen for this study to clarify key concepts and provide a broad overview of the SOC as it relates to PSP mental health. This review was conducted using the five-stage scoping review framework and reported using the PRISMA-ScR checklist [22-24]. Prior to starting the review, an a priori protocol was developed and registered with Open Science Framework (10.17605/OSF.IO/Z7ME2).

Data sources and searches

A systematic approach was used to identify relevant articles among several databases, "grey" literature, and thorough hand-searching. In this review, seven databases were searched: PsychINFO (ProQuest), SCOPUS, PubMed, Web of Science (core collection), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Open Grey Repository, and Nursing and Allied Health (ProQuest). Hand searching using the search strategy in Table 1 was completed through an advanced Google search and in several key journals: Behavioural and Cognitive Psychology Journal, Journal of Occupational Health Psychology, Journal of Occupational Health, and Journal of Occupational Rehab. To ensure all relevant studies were captured, another form of hand searching was used, backward citation, where authors hand searched the reference lists of included articles for relevant studies. In consultation with a librarian, a search strategy was selected using a combination of keywords, exact phrases, and operators that yield the widest range of relevant articles. The search strategy was employed uniformly across all databases and can be seen in Table 1. There were no filters or limitations in these searches, except for PsychINFO, Scopus, and Nursing and Allied Health, where the search was performed in all fields except full text to limit large quantities of irrelevant articles. The searches were all performed on June 21st, 2022**.**

Table 1. Search strategy

Key concept	**Sense of Coherence**	**First responder**	**Paramedic**	**Firefighter**	**Police officer**
Key words:	[1] "Sense of coherence"	[4] First responder*	[10] Paramedic*	[15] Firefighter*	[18] Police officer*
	[2] Salutogenesis	[5]First-responder*	[11] Ambulance personnel	[16] Fire officer*	[19] Police personnel
	[3] Salutogenic	[6] Public safety personnel	[12] EMS	[17] Firemen	
		[7] Public-safety personnel	[13] Emergency medical service*		
		[8] Emergency dispatcher*	[14] Emergency medicine		
		[9] Emergency personnel			

Note: The search strategy was combined using (sense of coherence key terms) AND (first responder key terms OR paramedic key terms OR firefighter key terms OR police officer key terms)

Study selection

After the initial search was complete, they were uploaded to a data screening and extraction tool (COVIDENCE), and all duplicates were deleted. The articles were then reviewed independently by two authors in two sequential screening stages: title and abstract and full-text review, to determine if they met the eligibility criteria. If an article passed the title and abstract screening stage, it moved onto the full-text review stage to determine eligibility for the current study. Any disagree-

ment between the two reviewers on study selection was resolved through discussion to reach a consensus. The inter-rater agreement between the reviewers was measured using Cohen's Kappa statistic, which showed good agreement in the title and abstract screening (k=0.69) and perfect agreement in the full-text screening stage (k=1). Articles were eligible for inclusion if they evaluated firefighters, paramedics, or police officers and SOC as it relates to mental health/illness. Articles were excluded if they did not directly assess SOC or did not assess all three elements of the SOC (i.e., comprehensibility, manageability, and meaningfulness). There was no restriction on year, language, or country of publication, and articles were eligible for inclusion if they were peer-reviewed articles, academic dissertations, chapters, or conference presentations.

Data charting process

Key information to extract from the articles was selected a priori. The two reviewers independently piloted the extraction among three randomly selected articles and iteratively revised the information being extracted based on discussion and feedback. After the pilot, the two reviewers independently extracted and collated the key information from each article and compared results to ensure accuracy. Any disagreements between the reviewers were resolved through discussion to reach a consensus. The following information was extracted and summarized from each article: author(s), year of publication, country of publication, objective(s), type of study, number of participants, population(s) of interest, age, ethnicity, years of active duty, definition of SOC, measurement of SOC, mental health outcomes of interest and measurement, physical health outcomes of interest and measurement, other measures of interest and measurement, results, if a particular element of the SOC determined more/less "important", and future applicability. After the data was extracted, descriptive statistics were used to summarize the data and frequencies and percentages were used to describe the nominal data.

Critical appraisal of the quality of evidence process

A critical appraisal was conducted because one of the main objectives of this paper is to determine the current state of the causal inference. A critical analysis of the quality of evidence was performed to determine how confident we are in the results and impact on causality. The quality of the included studies was assessed using the Quality in Prognostic Studies tool. This tool assesses six domains of bias: study participation, study attrition, prognostic factor measurement, outcome measurement, confounding measurement and account, and analysis and reporting [25]. Two reviewers independently reviewed each included article and rated each domain of bias and the overall article as high, moderate, or low risk-of-bias. The two reviewers then compared results, and any disagreement was resolved through consensus.

Critical analysis of causation

The Bradford Hill Criteria for causation is a widely accepted research tool utilized to determine if there is evidence of a causal relationship between a presumed cause and observed effect. Hill proposed nine aspects of association to evaluate epidemiological data to make a causal inference between a presumed cause and observed effect. The nine aspects of association that are used to determine a causal relationship are: [1] strength of the relationship, [2] consistency of the evidence, [3] specificity, [4] temporality of exposure, [5] biological gradient, [6] plausibility of the relationship, [7] coherence, [8] experimental evidence, and [9] analogy of similar relationships [26]. These aspects are fundamental principles of causal inference in epidemiology and are one of the most cited concepts in health research [26].

Establishing an argument for causation between a cause and effect is a vital step in research because it will influence future research, treatment, and prevention strategies. Such findings may also advance scientific knowledge of the mechanism leading to specific diseases. A critical analysis of causation is an underutilized tool, and when it is used, it is often in late stages of research (i.e., during or after a systematic review and meta-analysis). However, a critical analysis of causation is greatly beneficial during earlier research stages, as it will guide future research targets. Hill's criteria for causation focuses on the interpretation of evidence using a widely accepted hypothesis testing approach, which systematically maps evidence and identifies gaps and limitations of a topic. The identification of gaps and limitations can be used to inform next steps in research aims and methods to move toward determining a causal inference. By performing a critical analysis of causation during earlier research stages, like a scoping review, as done in this study, we can systematically

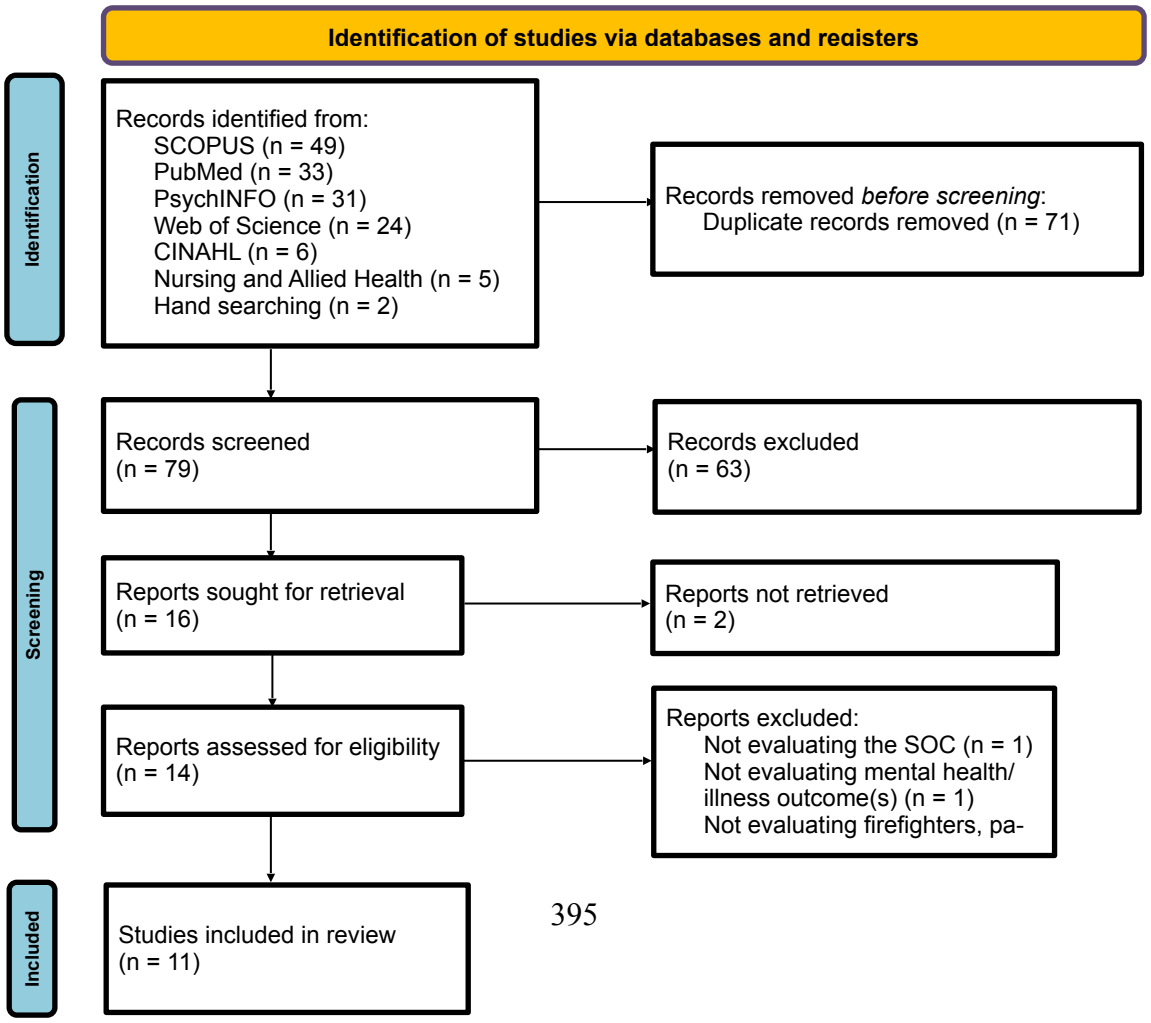
guide next steps in research to move towards developing an argument for causation. Additionally, we can avoid spending time and money on studies that may not be warranted based on the current body of literature.

Current literature on the SOC as it relates to PSP mental health is limited and unclear. A critical analysis of causation was performed to systematically map the current state of the literature and the causal inference. This analysis aimed to identify gaps and limitations within the current body of literature to inform future research goals and methods to effectively move toward a causal hypothesis. Hill's criteria for causation were chosen for this analysis as it is a widely accepted tool, is performed using a systematic approach, and identify evidence needed for a causal inference, where a causal inference is the highest form of evidence. In this study, a critical analysis of causation was performed by applying the nine aspects of association, as proposed by Hill, to determine the state of the causal inference using the included articles from this scoping review as the data.

RESULTS

A total of 150 articles were identified in the databases and uploaded to the systematic review software COVIDENCE. Notably, grey literature (via advanced Google search) and hand searching (via references of included articles) yielded articles that were already captured within the database searches and were not uploaded to COVIDENCE. After removing duplicates (n=71), a total of 79 studies were eligible for title and abstract screening. In the title and abstract screening stage, 63 articles were deemed irrelevant based on inclusion and exclusion criteria. Two articles were unable to be assessed in the full-text review stage as we were unable to obtain their full-text after searching several university databases and their libraries (University of Western Ontario, Lakehead University, University of Toronto, and McMaster University) and requesting the full-text from authors. There were 14 articles reviewed in the full-text screening stage, 3 articles were excluded (refer to Figure 1). Notably, one article met our inclusion criteria, but its results were pooled with populations outside our population of interest (prison officers, security guards, and city guards) [27]. This article was included as the remainder of the extracted information remains unaffected by the pooled results; however, the results of this study should be interpreted with caution and are marked with an asterisk. There is a total of 11 articles included in this review (Figure 1).

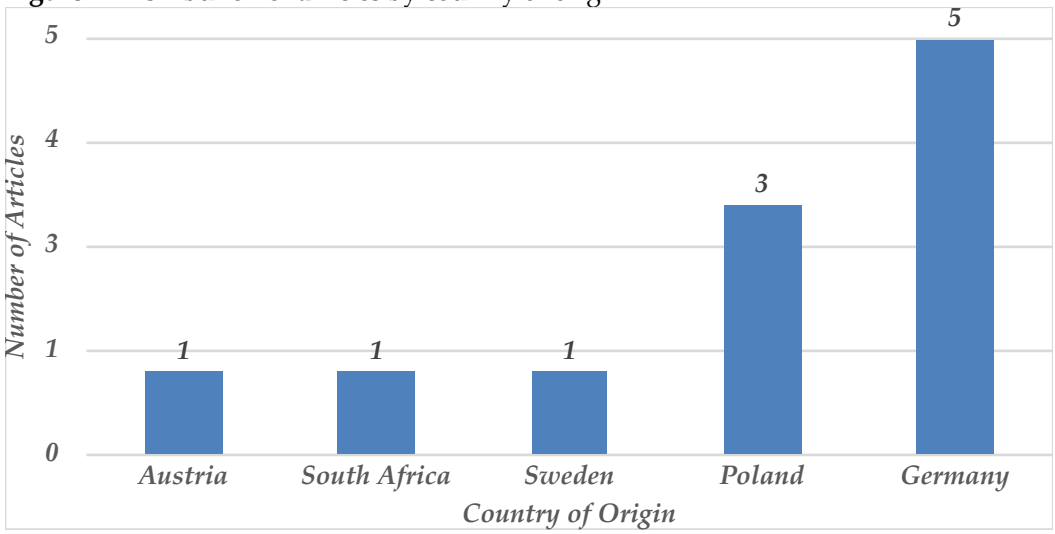
Figure 1. PRISMA flow chart



Distribution of articles by country and year of publication

The included articles originated from five different countries, most commonly the European Union (91%) (See Figure 2). The publication year of the articles ranged from 2000 to 2020; four articles (36%) were published between 2019 (n=2) and 2020 (n=2), and the remainder of the articles had one publication in the years 2000, 2003, 2005, 2008, 2011, 2012, and 2014.

Figure 2. Distribution of articles by country of origin



Participant information and demographics

The summary of participant information and demographics (population type, number of participants, age, sex, gender, and years of active duty) can be seen in the appendix in Table 1. There was a relatively even distribution of the PSP population(s) of interest in the included studies: five studies evaluated police officers, five evaluated firefighters, and three evaluated paramedics. There was one included study that evaluated "rescue workers" and did not specify the type of rescue worker [28]. This article was included based on the definition of a rescue worker and the nature of this review, as we are aiming to get a comprehensive and wide look at available literature. Additionally, 3 studies evaluated more than one population, all 3 of these studies were looking at police officers and firefighters and 2 of these studies also included population(s) outside the scope of this study (prison officers, security guards, city guards, physicians, and nurses) [27, 29, 30]. The sample size of the included articles had a large variance, from 51 to 974 participants. Although the population age, sex, gender, and years of active duty were similar among the included studies. The ethnicity of participants was also extracted from the included studies; however, ethnicity was only reported by two studies [31, 32]. In these studies, one had a 100% Caucasian sample and the other had a 56% black and 40% white sample (6% not reported) [31, 32].

Study design and objectives

There was little variation in the study design among the included studies; the majority (n=10, 91%) used a cross-sectional design, where one of these studies incorporated a secondary longitudinal component [29]. The remaining study used a prospective cohort design [32]. The objectives of the included studies were similar. All studies identified analyzed the association between SOC and mental health/illness outcomes as a primary or secondary objective. See Appendix in Table 1.

Definition and measurement of the SOC

The definition of the SOC in the included articles varied (Appendix Table 2). Two articles used the same definition that defined the SOC as "a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that 1) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable and explicable; 2) the resources are available to one to meet the demands posed by these stimuli; and 3) these demands are challenges, worthy of investment and engagement" [33, 34]. The remaining articles reported similar but less specific definitions. Three articles defined the SOC as a "perception that facilitates successful coping" [31, 35, 36]. Three articles defined the SOC as "perceiving

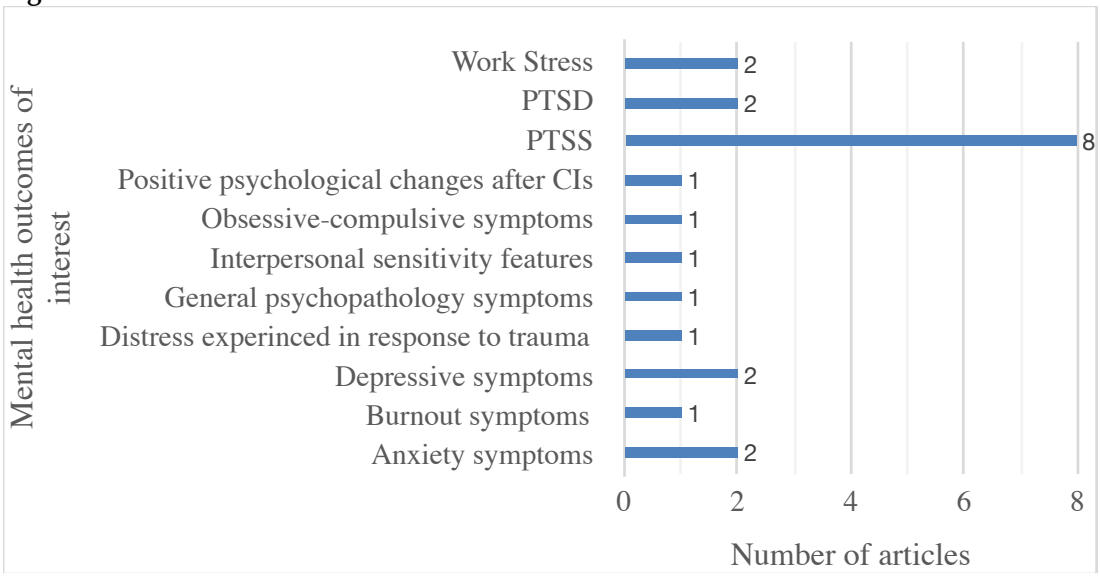
the inner and outer world as predictable and believing that things will work out as reasonably excepted" [30, 32, 35]. Two articles defined the SOC as the integration of the three elements of the SOC (i.e., comprehensibility, manageability, and meaningfulness) [14, 35]. One article defined SOC as "mastering life's adversities" [28]. The remaining two articles did not define SOC [27, 29].

There were five different scales used across all included studies to measure the SOC: SOC-27, SOC-R13, SOC-L9, SOC-13, and SOC-29. The most common scale used was the SOC-29 (n=4, 36%) and the SOC-13 (n=3, 27%). Notably, the SOC-29 was translated into Polish for two studies and into German for one study, the SOC-19 was translated into German for one study and into Swedish for one study, and the SOC-L9 was translated into German for one study. Refer to Appendix Table 3.

Mental health outcomes of interest

There were eleven different mental health outcomes assessed across studies (Figure 3). The most studied outcome was PTSS (i.e., symptoms that commonly occur with PTSD, but a diagnosis has not been made), assessed in 73% of studies. Studies also included physical health and other outcomes of interest and measurement; refer to the Appendix Table 3.

Figure 3. Mental health outcomes of interest in the included studies



Results and future applicability

There were eleven different mental health outcomes assessed in the included articles (Figure 3). Two outcomes were not reported in relation to the SOC: obsessive-compulsive symptoms and interpersonal sensitivity features. The results of the included studies showed that a higher SOC had statistically significantly lower adverse mental health outcomes in ten articles (91%) and higher positive mental health outcomes in one article (Table 2). One study found no significant findings between the SOC and mental health outcomes. Notably, the effect size was not given for several studies. To interpret the effect size of the relationship between SOC and mental health outcomes, the authors calculated the effect size using Cohen's d if enough information was present in the given study.

Table 2 Summary of included articles

Article	Population	Number of participants	Mental health outcomes of interest and measurement	Results
Schäfer et al., 2020	P, FFs, and medical staff	580 (257 P, 100 FFs, 223 Medical staff)	(1) General psychopathology symptoms via the 53-item Brief Symptom Inventory (BSI) (2) PTSS via the 22-item Impact of Event Scale-Revised (IES-R) (3) Burnout symptoms via the 22-item Maslach Burnout Inventory (MBI)	Higher levels of SOC showed significantly lower general psychopathological symptom burden (Police: r= -0.49, p< 0.05, Firefighters: r= -0.68, p< 0.05, Medical staff: r= -0.68, p<0.05). Higher SOC total score had significantly lower post-traumatic stress symptoms (police: r= -0.36, p< 0.05, firefighters: r= -0.44, p< 0.05, medical staff: r= -0.24, p<0.05). Higher levels of SOC had significantly lower burnout symptoms (MBI EE: Police: r= -0.28, p< 0.05, Firefighters: r= -0.36, p< 0.05, Medical staff: r= -0.57, p<0.05; MBI DP: Police: r= -0.43, p< 0.05, Firefighters: r= -0.39, p< 0.05, Medical staff: r= -0.43, p<0.05; MBI PA: Police: r= -0.43, p< 0.05, Firefighters: r= -0.39, p< 0.05, Medical staff: r= -0.44, p<0.05).
Schnell et al., 2020	FFs	232	(1) PTSD symptom severity via the Post-traumatic Stress Diagnostic Scale.	SOC was tested as a mediator between resilience and PTSD symptoms in this study. "Resilience only exerted an indirect influence on PTSD symptom severity that was largely mediated by SOC. [Notably,] resilience accounted for 24% of the SOC variance. SOC was highly correlated with PTSD symptom severity (r= -0.46, p < 0.001). Age, years of job experience were also associated with SOC but not PTSD symptom severity, which "might constitute additional variables that influence the relation of interest."
Behnke et al., 2019	"Rescue workers"	102	(1) PTSS via the PTSD Checklist for DSM-5 (PCL-5) (2) Depressive symptoms via the 9-item depression scale of the Patient Health Questionnaire (PHQ-9)	A high total SOC score was significantly correlated with lower depressive symptoms (β = -0.26, p< 0.01). The SOC total score did not have a significant relationship with post-traumatic stress symptoms (β= −0.09). However, higher SOC-R in manageability scores were associated with less post-traumatic stress (β=−.31, p=.009) and depressive (β=−.44, p< 0.001) symptoms.

Ragger et al., 2019	PM	266	(1) PTSS via 22-item Impact of Event Scale Revised (IES-R) (2) Positive psychological changes after experience of critical incidents via the 21-item Post-Traumatic Growth Inventory (PTGI)	"We found indications that a higher level of SOC seems to increase the probability for the development of PTG after the experience of critical incidents in the line of duty. ANOVAs showed significant cluster differences in SOC ($F(1,3)= 7.25$, $p< 0.01$): The cluster with PTG-high and PTSS-low showed a higher level of SOC than clusters with PTG-low. Higher levels of SOC are associated with higher levels of PTG [($r= 0.27$, $p< 0.01$)]. Higher levels of SOC were [also] associated with lower levels of the PTSS symptom Avoidance ($r = −0.17$, $p < 0.01$) and with a lower PTSD-Probability ($r = −0.14$, $p < 0.05$). We found positive associations between the SOC-subscale Meaningfulness and the PTG Total Score ($r= .27$, $p< .01$) plus the PTG-subscales New Possibilities ($r= .27$, $p< .01$), Relating to Others ($r= .31$, $p< .01$) and Appreciation of Life ($r= .14$, $p< .05$). [This may] underline the relevance of SOC and the possible significant role of the SOC-subscale Meaningfulness for the development of PTG after experiencing a critical incident."
Streb et al., 2014	PM	668	(1) PTSS via the 17-item Posttraumatic Stress Diagnostic Scale	“SOC was significantly correlated with the severity of PTSD symptoms ($r= -0.439$, $p<0.01$ at the two-tailed level). The correlation analysis revealed that, both resilience and SOC are associated with PTSD symptoms. The regression analysis showed that 19.2% of the total variance in symptom severity was explained by these variables. However, in the current sample SOC was a better predictor than resilience for severity of PTSD symptoms; SOC accounted for much more unique variance in symptoms than resilience [(SOC: $R2=0.19$, $t(645)=−10.50$, $p<.001$; Resilience: $R2=0.00$, $t(645)=−0.13$, $p=.89$)]."
Schütte et al., 2012	P	59	(1) PTSD via the PTSD module of the German version of the Structured Clinical Interview for DSM-IV	"For the prediction of PTSD after six months, logistic regression analysis showed that sense of coherence was not significantly associated with the prediction of PTSD development ($B= 0.04$, $SE= 0.04$, $Wald= 0.71$, $p=0.40$)."

Dudek & Szymczak, 2011	Study 1: FFs Study 2: P	*Study 1:* 974 *Study 2:* 399	(1) PTSS via 17-question Questionnaire for PTSD Measurement (K-PTSD)	Study 1: "The correlation coefficients between K-PTSD and SOC were –0.35 ($p < 0.001$) in the group of firefighters and –0.47 ($p < 0.001$) in that of police officer. The results obtained point to [a] protective role of SOC in the development of the PTSD symptoms. Study 2: "The finding indicates that the highest and lowest SOC subjects presented with the highest level of PTSD symptoms while the medium SOC subjects were characterized by the lowest level of PTSD ($F (2.31) = 1.900$, $p > 0.05$). [However, this finding was] not significant. We suppose that the factor accounting for this result may have been the small number of subjects."
Kassen & DiLalla, 2008	P	51	(1) Operative work stressors via true-false format made by the authors (2) Anxiety, depression, obsessive-compulsive, and interpersonal sensitivity features via the 58-item Hopkins Symptom Checklist (HSCL) (3) Distress in response to trauma via the 22-item Impact of Events Scale Revised (IES-R)	"The SOC was associated with lower levels of subjective stress (i.e., HSCL) ($\beta = -0.39$, $t (47) = -3.035$; $p<0.005$). The relative association between SOC and subjective stress was notably higher than that of SOC with traumatic stress (i.e., IES-R). [The regression analysis revealed that (1)] when the SOC was entered into the [traumatic stress] model, $F (4, 46) = 10.96$; $p < 0.001$; $R2 = 0.488$, [and (2)] when adding the SOC at step three of the [subjective stress] model, $F (4, 46) = 20.96$; $p < 0.001$; $R2 = 0.646$, resulting in a significant change in the model variance ($\Delta F = 9.21$; $p < 0.004$)."
Ogińska-Bulik, 2005*	"Uniformed professionals" (P, FFs, prison officers, and security and city guards)	330 (70 P, 70 FFs, 60 prison officers, 70 security guards, and 60 city guards)	(1) Job stress vis Perceived Job Stress Questionnaire (PJSQ) (2) Anxiety and depression symptoms via the 28-item General Health Questionnaire (GHQ-28)	"The cross-sectional path model revealed that the SOC had a direct impact on perceived stress in the workplace (PJSQ) (the generalized least squares estimation: – 0.44, $p<0.001$). The results indicated that stronger SOC reduced the sense of perceived stress in the workplace. [However,] path analysis indicated that the SOC [did not have an impact on] mental health status."

Jonsson et al., 2003	PM	362	(1) PTSS via Impact Event Scale (IES-15) and the Post Traumatic Symptom Scale (PTSS-10)	"There is strong evidence that lower SOC predict the outcome of higher scores on IES-15 and PTSS-10 subscales [(IES-15 r= -0.303 $p < 0.01$ at the two-tailed level, PTSS-10 r= -0.403 $p < 0.01$ at the two-tailed level)]."
Dudek & Koniarek, 2000	FFs	n total= 464, PTSD sample n=378	(1) PTSD and PTSD symptom severity via self-report PTSD-interview questionnaire (PTSD-I)	"The SOC level in the PTSD subjects was significantly lower than that in the non-PTSD ones ($F = 4.71$, $p < 0.05$). The higher the SOC score, the lesser the intensity of the disorder symptoms following the traumatic stress. The SOC had a significant negative association at the $p < 0.01$ and < 0.001 level for all 3 elements of the SOC and PTSD symptoms (trauma reexperiencing, avoidance, arousal, and trauma global score), except for meaningfulness and trauma reexperiencing. The strongest correlation was found between comprehensibility and the PTSD symptom avoidance [(r= -0.33, $p < 0.001$)]."

Note: police officers (P), firefighters (FFs), paramedic (P)

The SOC and PTSS. Eight studies (73%) assessed the relationship between SOC and PTSS. Six (75%) of these studies found that higher SOC scores were associated with lower severity of PTSS; there was a small (r=-0.27, p<0.001) association observed in one study and medium (r= -0.35 to -0.47, p < 0.05 to 0.001) associations observed in five studies (83%) [37]. One study found a medium association (β = -0.31, p=0.009) that only higher manageability scores on the SOC scale were associated with lower severity of PTSS [37]. The remaining study found a small association (r= -0.17, p<0.01) that higher SOC scores were associated with lower severity of the PTSS subscale avoidance [37].

The SOC and PTSD. Two studies assessed the relationship between SOC and PTSD. One study found that higher SOC scores on the subscales' comprehensibility and meaningfulness were associated with lower rates of PTSD (F=4.895, p<0.03 and F=1.190, p<0.03); however, not enough data was given to interpret or calculate the effect size of this relationship. The remaining study had no significant findings.

The SOC and depressive symptoms. Two studies assessed the relationship between SOC and depressive symptoms. Both studies found that higher SOC scores were associated with lower severity of depressive symptoms. These studies both observed a small association between SOC and depressive symptoms (β = -0.26, p< 0.01; t= -4.29*, p=0.001*, d= 0.47*) [37].

The SOC and work stress. Two studies assessed the relationship between SOC and work stress. Both studies found that higher SOC scores were associated with lower severity of work stress. One study observed a medium association (β= -0.39, p<0.005). The remaining study observed a small association when pooled with several different "personal resource" variables (self-esteem, self-efficacy, dispositional optimism, and social support) (pooled: t= -2.31*, p= 0.02*, d= 0.26*; non-pooled generalized least squares estimation= -0.44*, p<0.001*).

The SOC and anxiety symptoms. Two studies assessed the relationship between SOC and anxiety symptoms. One study found a small association (t=-4.28*, p=0.001*, d=0.48*) in a pooled analysis that high SOC, self-esteem, self-efficacy, dispositional optimism, and social support were associated with lower severity of anxiety/insomnia symptoms [37]. The remaining study did not report the relationship between SOC and anxiety symptoms [31].

The SOC and distress experienced in response to trauma. One study assessed the relationship between SOC and distress experienced in response to trauma. They found that higher SOC scores were associated with lower severity of distress experienced in response to trauma (ΔF = 9.21, p < 0.004; ΔR2= 0.07, R2= 0.646, F (1,46) = 20.96, p<0.0001); however not enough data was given to interpret or calculate the effect size of this relationship.

The SOC and burnout symptoms. One study assessed the relationship between SOC and burnout symptoms. They found that higher levels of SOC were associated with lower severity in all three subscales of the Maslach Burnout Inventory; there was a small (r= -0.28, p< 0.05) association between the subscale emotional exhaustion among Police officers and there were medium associations (r= -0.36 to -0.43, p< 0.05) among the remainder of the subscales in Police officers and firefighters [37].

The SOC and general psychopathology symptoms. One study evaluated the relationship between SOC and general psychopathology symptoms. They found a medium association (r= -49, p< 0.05) among police officers and a large association (r=-0.68, p< 0.05) among firefighters that higher levels of SOC were associated with lower severity of general psychopathological symptom burden [37].

The SOC and positive psychological changes after CIs. One study evaluated the relationship between SOC and positive psychological changes after CIs. They found a small association (r=0.27, p< 0.01) that higher SOC scores were associated with greater positive psychological changes after CIs [37].

Importance of a particular element of the SOC. Three studies deemed a particular element of the SOC (i.e., manageability, comprehensibility, and meaningfulness) more important than the others, and one study deemed a particular element of the SOC (i.e., meaningfulness) less important. There were no consistent results reported across these three studies.

Future applicability. The future applicability and focus of future studies were reported in nine studies (82%). There were several common recommendations identified: [1] need for longi-

tudinal studies (n=5), [2] need for more studies on the mechanism of the SOC (n=5), [3] need to develop/pilot methods to promote/develop SOC (n=3), and [4] need for a more representative and female sample (n=2).

Quality of included studies

The quality of the included studies was assessed using the Quality in Prognostic Studies tool and summarized in *Table 3* using the risk-of-bias visualization tool [38]. Each study was assigned an overall low, medium, or high risk-of-bias. A low-risk study can be defined as a study that is unlikely to have biases that affect the results and conclusions [25]. A medium-risk study may have biases that affect the results and conclusions [25]. A high-risk study is likely to have biases that may affect the results and conclusions [25]. There should be caution when drawing conclusions based on studies that have a medium or high risk-of-bias. Four studies had an overall medium risk-of-bias, four studies had a low risk-of-bias, and three studies had a high risk-of-bias. The highest concerns among the included articles were regarding selection and attrition bias, and the most common concern was statistical analysis and reporting bias. The implications of these results will be discussed in the critical appraisal of the causal relationship and discussion. Notably, there were no confounding variables to account for in the SOC-mental health relationship; thus, this domain may be ignored.

Table 3. Quality in prognostic studies summary

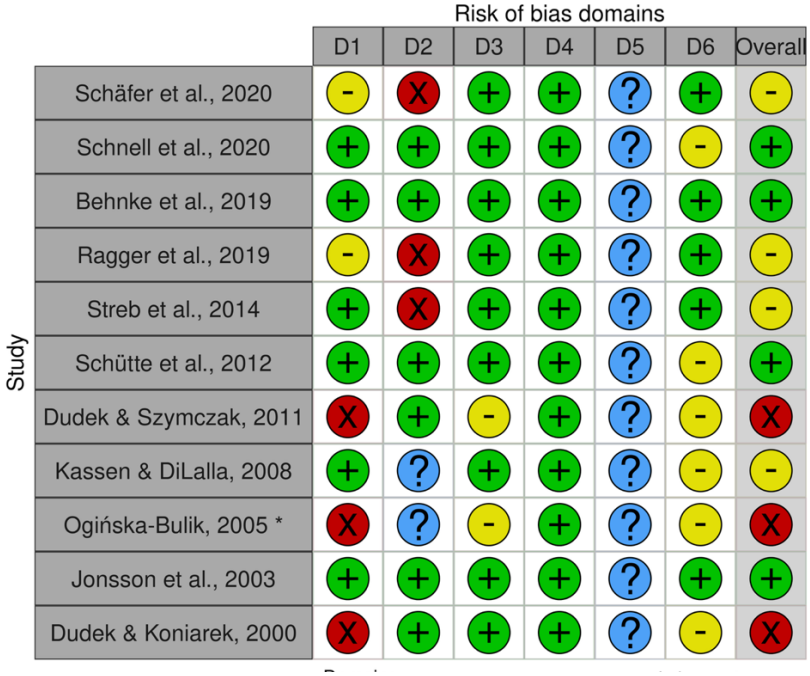


Table 3 legend:

Domains:
D1: Bias due to participation.
D2: Bias due to attrition.
D3: Bias due to prognostic factor measurement.
D4: Bias due to outcome measurement.
D5: Bias due to confounding.
D6: Bias in statistical analysis and reporting.

Judgement:
High
Moderate
Low
No information

Critical analysis of causation

A true critical analysis of causation, where we determine an argument of causation, cannot be performed during the early stages of research (i.e., scoping review). However, as discussed above, it can be used to map evidence and identify gaps, limitations, and next steps in research to move towards developing an argument for causation. In this section, we apply the nine aspects of association as proposed by Hill to determine the current state of the theoretical causal relationship between the SOC and PTSS among PSP. This analysis was performed among the eight papers from this scoping review that assessed the relationship between the SOC and PTSS. There were eight other mental health outcomes reported in relation to SOC in this scoping review; however, they were only assessed in one or two articles. Due to this small sample size, a critical analysis of causation was not performed among these remaining eight mental health outcomes.

Strength of the relationship. Hill's first criteria is the strength of the relationship, which states that the larger the association between the exposure and outcome of interest, the more likely it is to be a causal relationship [26]. Eight studies assessed the relationship between the SOC and PTSS. The results of these studies were inconsistent. Most of the studies (n=5, 63%) observed a medium association between the overall SOC score and lower PTSS. There was one small association observed, and the remaining two studies only observed a significant relationship among one of the subscales of SOC or PTSS. The quality of these studies varied largely in quality (n=3 low risk-of-bias, n=3 medium risk-of-bias, and n 2 high risk-of-bias). The variation in results, lack of large associations, and medium to high concern for bias in the majority of included studies results in the failure to meet this criterion.

Consistency of the evidence. The second criteria, consistency, refers to consistent results across multiple studies across various locations, populations, and methods [26]. There were four different study locations in the eight included articles; 50% of them were from Germany, and all originated within the European Union (*Figure 2*). Several PSP populations were included among these articles: firefighters, paramedics, and police officers. All studies used a cross-sectional design and showed that higher SOC were associated with less severe PTSS. However, as discussed above, there were variations in the size of the association, and some findings were only significant among subscales. Therefore, due to little variation in the study location and methods, and variation of results, the included studies fail to meet this criterion.

Specificity. Specificity is the third criteria, which suggests that an association is more likely to be causal when the exposure of interest only causes one disease [26]. This criterion is considered "weak" and sometimes "irrelevant" as many diseases have multiple causes and risk factors that may contribute to the development of the disease [26]. Further, the construct itself may overlap with other psychological traits such as self-efficacy, optimism, coping, or cognitive abilities like executive functioning. For these reasons, this criterion should be interpreted with caution. Where specificity is present, it can be a convincing criterion for causation. However, its absence does not necessarily mean that causation is absent, since many diseases are known to be multifactorial, or many exposures are known to cause multiple health conditions. In this study, we are interested in the causal relationship between the SOC and mental health outcomes among PSP. The SOC is one psychological theory that may mediate adverse mental health outcomes. However, there are many other theories and common wellness practices that may do the same, such as peer and family support, physical activity, and mental health treatment (e.g., support groups, talk therapy). There are a great deal of different exposures/practices that may mediate adverse mental health outcomes among PSP, the SOC is just one possible explanation; thus, the criterion of specificity cannot be met.

Temporality. The fourth criteria, temporality, is an essential criterion to meet that states that for an exposure-disease relationship to be causal, the exposure must occur before the onset of disease (26). In the relationship between the SOC and mental health outcomes, there is only one way to determine temporality, which is through longitudinal study designs. A longitudinal study among PSP would have to assess their baseline SOC at the start of their career and follow them for an extended period, continually evaluating their CI/stress exposures and mental health outcomes. A study of this nature would be able to determine temporality; however, no such study has been done to date, and therefore, this criterion cannot be met. Current literature, as identified

in this study, has almost exclusively been cross-sectional designs, which denies this principle and results from such studies should be interpreted with this in mind.

Biological gradient. The fourth criteria, biological gradient, refers to the observation of a dose-response. If a dose-response relationship is observed, it is more likely for the relationship to be causal [26]. In the included articles, there were no dose-response curve analyses reported; thus, this criterion cannot be determined. This represents a failure of prognostic or causation study designs to consider the basic principles outlined in Hill's criteria, since dose-response should be easily tested.

Plausibility. The criterion plausibility states that the proposed theoretical relationship must be consistent with existing biological and social models [26]. Aaron Antonovsky introduced the concept of salutogenesis and SOC in 1979, 43 years after the introduction of the general adaption syndrome by Hans Selye [39]. The model, as proposed by Hans Selye, has since been widely accepted and can be used as an example of existing biological and social models. The general adaption syndrome model describes the reactions of the body in response to stress and how such responses may lead to adverse health outcomes. There are three sequential stages in the model that result in either an adaptation or maladaptation to a stressor: [1] the acute/alarm stage, otherwise known as the fight-or-flight response (i.e., the initial reaction to a stressor); [2] the resistance stage, which is the ability for one to cope, if one can cope the stress response will end (i.e., adaption) and if they cannot they will continue to the last stage of the model; [3] the recovery or exhaustion stage, if the stressor is removed they will recover but if the stressor remains constant they will experience mental exhaustion (i.e., maladaptation) [39]. Both models point to coping abilities to determine if one can effectively manage stressful situations and conclude that there will be maladaptive outcomes (i.e., mental or physical) that result if they are unable to adapt to a stressor. Therefore, the SOC is consistent with existing biological and social models and meets this criterion.

Coherence. Coherence is the seventh criteria, which states that a cause-and-effect relationship should be consistent with all available knowledge and is more likely to be causal if it is consistent with what is already known about the disease/disorder [26]. The SOC and PTSS or other mental health outcomes have not been widely studied in PSP; however, there is available evidence from other populations. For example, a 2017 systematic review and meta-analysis on SOC and mental health among caregivers found a large negative association between SOC and subjective burden ($r=-0.53$; 95% CI $=-0.60,-0.46$; $N = 3{,}120$), depressive symptoms ($r=-0.69$; 95% CI $=-0.75,-0.63$; $N = 3{,}216$), and anxiety ($r=-0.60$; 95% CI $=-0.70,-0.47$; $N = 940$) [15, 37]. Consistent with these results, a 2022 systematic review on SOC and healthcare professionals found that SOC was negatively correlated with stress, depression, burnout, and PTSD and is positively correlated with job satisfaction, well-being, and quality of life [16]. These studies show that the SOC may act as a protective factor against adverse mental health outcomes. However, we are unable to conclude if these results are consistent among the PSP population due to the small number of studies and poor quality of evidence.

Experimental evidence. The eighth criteria states that evidence from experimental manipulation may be the strongest support for a causal relationship [26]. The SOC is an internal psychological mechanism which cannot be manipulated in an animal study design, and it is highly unethical to perform an experiment where participants are subjected to highly stressful situations as experienced by PSP to assess mental health outcomes. While it is not possible to manipulate stress purposefully, one form of experimental studies might be introducing interventions that target SOC and evaluating whether changes in SOC are associated with changes in mental health outcomes. No such interventional studies were found.

Analogy. The last criteria is analogy, which states that if there is strong evidence of a causal relationship between an exposure and disease, the "standards" of accepting evidence for a similar exposure and disease can be lowered [26]. There have been several systematic reviews and meta-analyses analyzing the SOC and mental health outcomes in other populations; however, these studies are limited by a small number of studies and inability to show temporality, thereby being unable to show causation [15, 17]. There is no strong evidence of a causal relationship between the SOC and mental health outcomes; thus, no such analogies can be drawn.

Currently, there is not enough literature or evidence to support a causal relationship between the SOC and PTSS among PSP. The current literature has failed to meet several causal criteria, particularly those involving strength, consistency, temporality, and experimental evidence. We argue that these three criteria are some of the most important causal criteria to meet in the SOC-mental health relationship and suggest that research should focus on these criteria when developing future studies. Several other causal criteria were unable to be assessed due to a lack of data or analysis of existing data, including biological gradient, coherence, and analogy. Future research is also needed within these areas to show causation. Lastly, we suggest that specificity is irrelevant in the SOC-mental health relationship and should not diminish the results of the remaining criteria in future analyses.

DISCUSSION

This review has concluded that current literature on SOC and mental health among PSP is homogenous with limited support for causality; however, results from these studies suggest that higher SOC may be a protective factor for adverse mental health outcomes. Eleven articles were identified; the majority of these studies used a cross-sectional design, assessing the relationship between SOC and PTSS. Most studies originated from the European Union, most commonly Germany, which may suggest that the SOC is a European concept that is less studied in North America. SOC may be less studied in North America because the definition of SOC may overlap with other commonly studied psychological traits, such as resiliency. Resiliency is the process of adapting to stressful events or trauma [18]. There is debate within the literature whether the two concepts have theoretical and empirical overlap, or if they are different concepts, both contributing to good health [18]. We hypothesize that SOC and resiliency have some overlap, specifically that resiliency may be encompassed within the manageability component of SOC. While the extant literature is sparse, the results suggest that the existing literature is homogenous in terms of study design, methods, and locations.

There was an increase in article publication between 2019 and 2020, which is consistent with the general literature on SOC that has also had increased publications over the last five years. Interestingly, there is a larger body of literature available on SOC and mental health outcomes among other healthcare professionals, which suggests that PSP was not a common study population. Therefore, SOC is a "new" concept within PSP, which may explain the limited number of articles identified in this review. As the SOC is understudied, it is not surprising that the literature identified was predominantly cross-sectional designs, as this is a common design choice for emerging concepts. However, this design choice leaves a gap in the literature about temporality and the effectiveness of using the SOC as an intervention. The mental health outcome of interest was consistent with existing literature among PSP, where there is a large focus on PTSD and PTSS. This focus on PTSD and PTSS is another gap in the literature as it neglects other common occupational stress injuries, such as anxiety and depression symptoms/diagnoses.

The results of the included articles showed that a higher SOC was associated with lower severity of adverse mental health outcomes in ten articles and higher positive mental health outcomes in one article. These results are consistent with existing literature on the SOC and mental health outcomes in other populations. For example, González-Siles and colleagues performed a systematic review among healthcare professionals and concluded that SOC is negatively correlated with stress, depression, burnout, and PTSD and is positively correlated with job satisfaction, well-being, and quality of life [16]. Consistent with these results, a 2020 systematic review on SOC and nurses found that SOC was a protective factor for depressive symptoms and burnout among female nurses and was also shown to enhance good mental health [17]. However, most of the studies included in this review had a medium to high risk-of-bias. The most common concern for bias was selection bias, specifically due to the risk of an overfit sample. With the low number of studies in this area, coupled with the medium to high risk-of-bias, the results of these studies should be interpreted with caution.

As hypothesized, the critical analysis of causation between SOC and PTSS showed limited support for a theoretical causal relationship. This is largely due to the small number of articles available and homogenous study designs, as we were unable to assess several causal criteria. This analysis uniquely contributes to the existing body of literature, as we have analyzed it and identi-

fied gaps and limitations based on Hill's criteria. This allowed us to suggest future research targets incorporating Hill's criteria to move future research toward establishing an argument for causation.

If there is evidence of a causal relationship, it could provide PSP with treatment and prevention strategies, which may decrease the incidence of adverse mental health outcomes. PSP have significantly higher rates of occupational stress injuries and adverse mental health outcomes [2, 5, 6, 7, 8, 9]. This suggests that the current mental health strategies are not sufficient and there is a need for additional treatment and prevention strategies. Current literature among other professions with high occupational stress demands shows promising results that the SOC may act as a protective factor against adverse mental health outcomes [16, 17]. However, data on interventional studies is scarce within these populations as well, and additional research is required. Such results may add confidence to the use of the SOC theory among PSP. However, research among the PSP population would still be needed as they have unique job requirements (e.g., first on scene) and culture within each sector that may impact results.

Limitations

This study utilized a rigorous systematic approach to map existing literature, chart data, and critically appraise the quality of evidence. The protocol was built in iterative consultation with all authors, and each stage of this review utilized a two-reviewer process. We are confident that this review has covered all relevant literature and was presented according to scoping review methodology [22-24]. However, there are several limitations to this study, including, small number of included articles, predominantly European countries as the study population, the quality of included articles, reporting inconsistencies, missing data, and the inclusion of pooled results.

There was a small number of articles included in this scoping review, which affects the ability to draw conclusions about the SOC and mental health outcomes among PSP. 91% of included articles originated from the European Union, which may limit the generalizability of the findings outside of the European Union. Most of the included studies had a medium to high risk-of-bias, which raises concerns for our confidence in the results of these studies. This review is further limited by reporting inconsistencies among the included articles. Several included articles were noted to measure PTSS but reported on the outcome of PTSD. The PTSS scale can predict the outcome of PTSD; however, a PTSD diagnosis cannot be determined without consultation with a qualified medical professional. In this case, we only reported based on what was measured. Additionally, as noted in the results section, the effect size and relationship between SOC and mental health outcomes were missing for several studies. The authors attempted to calculate the effect size for all included articles to interpret the data; however, one study did not provide enough information to calculate the effect size. Lastly, one article met our inclusion criteria, but the results were pooled with several populations outside our population of interest (prison officers, security guards, and city guards) [27]. This article was included as the remainder of the extracted information remains unaffected by the pooled results. The results of this study should be interpreted with caution and are marked with an asterisk throughout this scoping review.

Conclusions and future research targets

The literature surrounding the SOC as it relates to PSP mental health is limited, with little variation in study design and location, and there are concerns about the quality of this evidence. The current evidence for causality between SOC and PTSS is preliminary, with limited support for causality. Included studies have failed to integrate quality assessment and Hill's aspects of association to hypothesize a causal relationship. Although the SOC, as it relates to mental health, is consistent with existing biological and social models, there is some evidence that the SOC may act as a protective factor in other populations, and there were low to moderate associations found in this scoping review. These findings are sufficient to warrant future research. We suggest that future research should focus on longitudinal and interventional study designs among a variety of populations, locations, and methods; and should integrate causation-based hypothesis testing in study protocols, analyses, and interpretation. These studies should analyze several mental health outcomes and routinely include dose-response curves to get a comprehensive picture of PSP mental health status.

Implementing longitudinal and interventional studies among PSP may be limited by cost, time, and potentially large dropout rates. Additionally, interventional studies would have to create customized intervention programs that are specific to each PSP population of interest. Antonovsky conceptualized the SOC as a cross-cultural concept that differs across cultures, careers, and settings [18]. Therefore, to develop an effective intervention, it must be specific to the population it is targeting and their unique experiences. Antonovsky initially hypothesized that the SOC becomes stable in adulthood; however, there are mixed results in the literature [18]. Thus, it is unknown if the SOC can be "taught".

As identified in this paper, the SOC may overlap with other psychological traits such as self-efficacy, optimism, coping, and resiliency. A preliminary step to justify the large cost, time, and unknowns associated with longitudinal and interventional studies may be performing correlational analyses among SOC and other widely studied psychological traits. This will determine if there is and how much overlap is present. If there is near-perfect correlation with existing psychological traits, such as resiliency, this may indicate that the SOC is a European concept and SOC may help reach a consensus on the definition, conceptualization, and measurement of the term resiliency. If there is some correlation with existing psychological traits, such as resiliency, which has a large body of literature, this evidence may be used as further justification for performing longitudinal and intervention studies.

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Institutional Review Board Statement: Not applicable as this was a scoping review and ethical approval was not necessary.

References

1. Canadian Institute for Public Safety Research and Treatment [Internet]. [cited 2023 Jun 19]. Glossary of Terms Public Safety Personnel (PSP). Available from: https://www.cipsrt-icrtsp.ca/en/glossary/public-safety-personnel-psp.
2. Wagner SL, White N, Regehr C, White M, Alden LE, Buys N, et al. Ambulance personnel: Systematic review of mental health symptoms. Traumatology (Tallahass Fla). 2020 Dec;26(4). doi: doi.org/10.1037/trm0000251.
3. Nazari G, MacDermid JC, Sinden K, D'Amico R, Brazil A, Carleton N, et al. Prevalence of exposure to critical incidents in firefighters across Canada. Work. 2020;67(1):215-222. doi: 10.3233/WOR-203267. PMID: 32955483.
4. Klimley KE, Van Hasselt VB, Stripling AM. Posttraumatic stress disorder in police, firefighters, and emergency dispatchers. Vol. 43, Aggression and Violent Behavior. Elsevier Ltd; 2018. p. 33–44. doi: 10.1016/j.avb.2018.08.005.
5. Mat Salleh MNB, Ismail DHB, Mohd Yusoff DHB. Prevalence and Predictors for PTSD among Firefighters. A Systematic Review. Int. J. Pub. Health Res. [Internet]. 2020 Apr. 10;10(1). Available from: https://spaj.ukm.my/ijphr/index.php/ijphr/article/view/259.
6. Wagner SL, White N, Fyfe T, Matthews LR, Randall C, Regehr C, et al. Systematic review of post-traumatic stress disorder in police officers following routine work-related critical incident exposure. Am J Ind Med. 2020 Jul;63(7):600-615. doi: 10.1002/ajim.23120. Epub 2020 May 17. PMID: 32419181.
7. Ntatamala I, Adams S. The Correlates of Post-Traumatic Stress Disorder in Ambulance Personnel and Barriers Faced in Accessing Care for Work-Related Stress. Int J Environ Res Public Health. 2022 Feb 11;19(4):2046. doi: 10.3390/ijerph19042046. PMID: 35206234; PMCID: PMC8871647.

8. Petrie K, Milligan-Saville J, Gayed A, Deady M, Phelps A, Dell L, et al. Prevalence of PTSD and common mental disorders amongst ambulance personnel: a systematic review and meta-analysis. Soc Psychiatry Psychiatr Epidemiol. 2018 Sep;53(9):897-909. doi: 10.1007/s00127-018-1539-5. Epub 2018 Jun 5. PMID: 29869691.
9. Alghamdi M, Hunt N, Thomas S. Prevalence rate of PTSD, Depression and Anxiety symptoms among Saudi Firefighters. J Trauma Stress Disord Treat. 2017;06(01). doi: 10.4172/2324-8947.1000164.
10. Mittelmark MB, Bauer GF. The Meanings of Salutogenesis. 2016 Sep 3. In: Mittelmark MB, Sagy S, Eriksson M, Bauer GF, Pelikan JM, Lindström B, Espnes GA, editors. The Handbook of Salutogenesis [Internet]. Cham (CH): Springer; 2017. Chapter 2. PMID: 28590655.
11. Eriksson M. The Sense of Coherence in the Salutogenic Model of Health. 2016 Sep 3. In: Mittelmark MB, Sagy S, Eriksson M, Bauer GF, Pelikan JM, Lindström B, Espnes GA, editors. The Handbook of Salutogenesis [Internet]. Cham (CH): Springer; 2017. Chapter 11. PMID: 28590620.
12. Adameova A, Abdellatif Y, Dhalla NS. Role of the excessive amounts of circulating catecholamines and glucocorticoids in stress-induced heart disease. Can J Physiol Pharmacol. 2009 Jul;87(7):493-514. doi: 10.1139/y09-042. PMID: 19767873.
13. Duric V, Clayton S, Leong ML, Yuan LL. Comorbidity Factors and Brain Mechanisms Linking Chronic Stress and Systemic Illness. Neural Plast. 2016;2016:5460732. doi: 10.1155/2016/5460732. Epub 2016 Feb 8. PMID: 26977323; PMCID: PMC4761674.
14. Ragger K, Hiebler-Ragger M, Herzog G, Kapfhammer HP, Unterrainer HF. Sense of coherence is linked to post-traumatic growth after critical incidents in Austrian ambulance personnel. BMC Psychiatry. 2019 Mar 11;19(1):89. doi: 10.1186/s12888-019-2065-z. PMID: 30866860; PMCID: PMC6417083.
15. Del-Pino-Casado R, Espinosa-Medina A, López-Martínez C, Orgeta V. Sense of coherence, burden and mental health in caregiving: A systematic review and meta-analysis. J Affect Disord. 2019 Jan 1;242:14-21. doi: 10.1016/j.jad.2018.08.002. Epub 2018 Aug 9. PMID: 30170234.
16. González-Siles P, Martí-Vilar M, González-Sala F, Merino-Soto C, Toledano-Toledano F. Sense of Coherence and Work Stress or Well-Being in Care Professionals: A Systematic Review. Healthcare (Basel). 2022 Jul 20;10(7):1347. doi: 10.3390/healthcare10071347. PMID: 35885873; PMCID: PMC9323122.
17. Masanotti GM, Paolucci S, Abbafati E, Serratore C, Caricato M. Sense of Coherence in Nurses: A Systematic Review. Int J Environ Res Public Health. 2020 Mar 13;17(6):1861. doi: 10.3390/ijerph17061861. PMID: 32183042; PMCID: PMC7142757.
18. Fossion P, Leys C, Kempenaers C, Braun S, Verbanck P, Linkowski P. Disentangling Sense of Coherence and Resilience in case of multiple traumas. J Affect Disord. 2014 May;160:21-6. doi: 10.1016/j.jad.2014.02.029. Epub 2014 Feb 28. PMID: 24709018.
19. Vella SL, Pai N. A theoretical review of psychological resilience: Defining resilience and resilience research over the decades. Archives of Medicine and Health Sciences. 2019;7(2):233. https://hdl.handle.net/10779/uow.27759282.v1.
20. Aburn G, Gott M, Hoare K. What is resilience? An Integrative Review of the empirical literature. J Adv Nurs. 2016 May;72(5):980-1000. doi: 10.1111/jan.12888. Epub 2016 Jan 7. PMID: 26748456.
21. Grevenstein D, Bluemke M. Measurement Invariance of the SOC-13 Sense of Coherence Scale Across Gender and Age Groups. European Journal of Psychological Assessment. 2022 Jan;38(1):61–71. doi: 10.1027/1015-5759/a000641.
22. Arksey H, O'Malley L. Scoping studies: Towards a methodological framework. International Journal of Social Research Methodology: Theory and Practice. 2005 Feb;8(1):19–32. doi: 10.1080/1364557032000119616.
23. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. Implement Sci. 2010 Sep 20;5:69. doi: 10.1186/1748-5908-5-69. PMID: 20854677; PMCID: PMC2954944.
24. Peters MDJ, Marnie C, Tricco AC, Pollock D, Munn Z, Alexander L, et al. Updated methodological guidance for the conduct of scoping reviews. JBI Evid Synth. 2020 Oct;18(10):2119-2126. doi: 10.11124/JBIES-20-00167. PMID: 33038124.
25. Hayden JA, van der Windt DA, Cartwright JL, Côté P, Bombardier C. Assessing bias in studies of prognostic factors. Ann Intern Med. 2013 Feb 19;158(4):280-6. doi: 10.7326/0003-4819-158-4-201302190-00009. PMID: 23420236.

26. Fedak KM, Bernal A, Capshaw ZA, Gross S. Applying the Bradford Hill criteria in the 21st century: how data integration has changed causal inference in molecular epidemiology. Emerg Themes Epidemiol. 2015 Sep 30;12:14. doi: 10.1186/s12982-015-0037-4. PMID: 26425136; PMCID: PMC4589117.
27. Ogińska-Bulik N. The role of personal and social resources in preventing adverse health outcomes in employees of uniformed professions. Int J Occup Med Environ Health. 2005;18(3):233-40. PMID: 16411561.
28. Behnke A, Conrad D, Kolassa IT, Rojas R. Higher sense of coherence is associated with better mental and physical health in emergency medical services: results from investigations on the revised sense of coherence scale (SOC-R) in rescue workers. Eur J Psychotraumatol. 2019 May 20;10(1):1606628. doi: 10.1080/20008198.2019.1606628. PMID: 31164965; PMCID: PMC6534248.
29. Dudek B, Szymczak W. The role of cognitive schemata in the development of posttraumatic stress disorder: results of cross-sectional and longitudinal studies. Int J Occup Med Environ Health. 2011 Mar;24(1):29-35. doi: 10.2478/s13382-011-0010-6. Epub 2011 Feb 16. PMID: 21468900.
30. Schäfer SK, Sopp MR, Staginnus M, Lass-Hennemann J, Michael T. Correlates of mental health in occupations at risk for traumatization: a cross-sectional study. BMC Psychiatry. 2020 Jun 25;20(1):335. doi: 10.1186/s12888-020-02704-y. PMID: 32586338; PMCID: PMC7318450.
31. Kassen M, DiLalla D. Maladaptive defense style and traumatic stress reactions in a specialized unit of the South African police service. J Forensic Psychol Pract. 2008;8(3):262–79. doi: 10.1080/15228930802282014.
32. Schütte N, Bär O, Weiss U, Heuft G. Prediction of PTSD in police officers after six months--a prospective study. Span J Psychol. 2012 Nov;15(3):1339-48. doi: 10.5209/rev_sjop.2012.v15.n3.39419. PMID: 23156937.
33. Dudek B, Koniarek J. Relationship between sense of coherence and post-traumatic stress disorder symptoms among firefighters. Int J Occup Med Environ Health. 2000;13(4):299-305. PMID: 11276843.
34. Jonsson A, Segesten K, Mattsson B. Post-traumatic stress among Swedish ambulance personnel. Emerg Med J. 2003 Jan;20(1):79-84. doi: 10.1136/emj.20.1.79. PMID: 12533382; PMCID: PMC1726002.
35. Schnell T, Suhr F, Weierstall-Pust R. Post-traumatic stress disorder in volunteer firefighters: influence of specific risk and protective factors. Eur J Psychotraumatol. 2020 Jun 17;11(1):1764722. doi: 10.1080/20008198.2020.1764722. PMID: 33029308; PMCID: PMC7473037.
36. Streb M, Häller P, Michael T. PTSD in paramedics: resilience and sense of coherence. Behav Cogn Psychother. 2014 Jul;42(4):452-63. doi: 10.1017/S1352465813000337. Epub 2013 May 29. PMID: 23714206.
37. Pallant J. SPSS survival manual. 7th ed. Open University Press; 2020.
38. McGuinness LA, Higgins JPT. Risk-of-bias VISualization (robvis): An R package and Shiny web app for visualizing risk-of-bias assessments. Res Synth Methods. 2021 Jan;12(1):55-61. doi: 10.1002/jrsm.1411. Epub 2020 May 6. PMID: 32336025.
39. McCarty R. The Alarm Phase and the General Adaptation Syndrome. In: G. Fink, editor. Stress: Concepts, cognition, emotion, and behavior; stress: Concepts, cognition, emotion, and behavior. San Diego, CA: Elsevier Academic Press; 2016. p. 69–90.