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REVIEW PAPER

Sense of coherence – its impact on health and the role of artificial intelligence: a modern life synthesis

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Abstract

In contemporary health discourse, individuals are expected to take an active role in maintaining their own health. Health promotion perspectives emphasize well-being and the capacity to cope effectively with stressors. Within this context, sense of coherence and artificial intelligence emerge as concepts of considerable relevance for health. The aim of this study was to examine evidence on the significance of a strong sense of coherence for health and to explore the role of artificial intelligence in health promotion and in supporting processes related to the development of sense of coherence. A narrative review of literature indicates that individuals with a stronger sense of coherence tend to report better physical and mental health outcomes. At the same time, artificial intelligence is increasingly being applied in health care, supporting health, rehabilitation, and digital self-management, offering new opportunities for personalized and accessible health support. The reviewed literature suggests that artificial intelligence may have the potential to contribute to the strengthening of sense of coherence by supporting individuals' perception of life as more comprehensible, manageable, and meaningful. The findings in this study highlight the importance of integrating salutogenic theory with contemporary digital innovation in order to better understand and support health in modern life.
Keywords: sense of coherence, artificial intelligence, salutogenesis, ethics, health

Introduction

In contemporary society, the concept of sense of coherence (SOC) is becoming increasingly relevant. Modern society is characterized by a growing trend towards individualism, a weakening of tradition and traditional social ties, and the central role of consumerism, social media, and diverse forms of identity and perception [1]. At the same time, artificial intelligence (AI) has developed rapidly and become an integral part of everyday life. As these social and technological changes reshape how individuals understand and navigate daily life, they raise important questions about adaptation, well-being, and health. These questions can be approached by analyzing three related but conceptually distinct issues: the role of SOC in health, the role of AI in health care, and the possibility that AI may influence SOC.

SOC is a concept used to understand how individuals maintain and promote health. It was first analyzed and interpreted by Aaron Antonovsky within the framework of salutogenesis [2]. This approach focuses on promotion and creation of health rather than on disease, offering a perspective centered on health promotion in society [3]. Within the framework, health is

supported by individuals' awareness and use of internal resistance resources which help them cope with stressors and solve problems. Antonovsky conceptualized SOC as comprising three interrelated components: comprehensibility, manageability, and meaningfulness [2-4]. Comprehensibility represents the cognitive component of SOC and refers to the extent to which individuals perceive internal and external environments as structured, predictable, and understandable. Manageability represents the behavioral component and relates to the extent to which individuals perceive their internal and external resources as sufficient to meet the demands of everyday life. Meaningfulness, the motivational component, concerns whether individuals perceive life situations and challenges as worthy of engagement and investment. Together, these three dimensions shape how individuals perceive and respond to everyday life. Strong SOC enables individuals to experience life as understandable, manageable, and meaningful, thereby promoting resilience and well-being. Research has consistently shown that higher levels of SOC are associated with better health outcomes [5-7], and strengthening SOC has been linked to improved coping with psychophysiological disorders [8,9]. According to Eriksson and Antonovsky, perceiving everyday life as understandable, manageable, and meaningful is an important factor in ensuring well-being and health [3,10,11]. SOC can therefore be understood as an important health-promoting resource, particularly in the context of ageing populations, chronic disease management, and the growing need for health literacy and empowerment [12,13].

In addition to Antonovsky's concept of SOC, AI is playing an increasingly important role in shaping health care. Technological change has always disrupted existing social and institutional systems, while simultaneously creating new opportunities [14]. In the current context, AI, digitalization, automatization, and biotechnology are transforming health systems and care practices [13]. AI offers potential for improving healthcare delivery and outcomes. Its capabilities in data analysis, pattern recognition, anomaly detection, robotics, and supportive mechanisms create new possibilities for diagnostics, prevention, treatment, and care coordination [15-17]. Welfare and AI-driven technologies are increasingly viewed as important tools for promoting population health, supporting independence, and improving accessibility and safety in care [18]. This is particularly evident in chronic disease management. Research in Slovenia has shown that mobile health (mHealth) services may play an important role in the sustainability of health systems and in supporting patients with chronic conditions, although users are often reluctant to adopt such services [19]. At the same time, the implementation of AI in health care raises important ethical and practical concerns. These include ensuring the

safety and confidentiality of patient data, addressing the risk of algorithmic bias, and maintaining transparency and accountability in AI supported systems. The integration of AI should therefore be implemented in a safe and transparent manner to effectively support patients and healthcare professionals [20,21].

A third issue concerns the possibility that AI may influence SOC. Can AI truly enhance autonomy, manageability, and meaningfulness, or might it, in some contexts, substitute for these processes rather than strengthen them? AI may not only affect healthcare delivery, but it may also shape the psychosocial conditions through which people experience health, including SOC. AI technologies do not serve merely technical functions, such as providing medical or technical support. They also influence how individuals perceive information, make decisions, solve problems, and relate to their environment. Within a salutogenic context, health is not defined simply as the absence of disease but as the extent to which individuals are able to perceive life as comprehensible, manageable, and meaningful [2-4,10,11]. SOC significantly shapes an individual's perception of life and the world around them. From this perspective, AI could be understood as a tool that reorganizes the structure of experiences related to health. It may strengthen SOC by enhancing cognitive clarity, providing practical support, and increasing perceived control. Through pattern recognition, predictive analytics, monitoring, and decision support, AI can potentially make aspects of health and illness more comprehensible, manageable, and meaningful [15,17,18]. This interpretation as such remains incomplete. The important question is whether AI supports human orientation and action or replaces them. If comprehensibility is defined or shaped by algorithms, if manageability becomes dependent on automatization, e.g. chatbots and other predictive systems, and if meaningfulness is reduced to optimized compliance, then AI may not deepen SOC but rather externalize it. In such cases, AI may offer or implement substitution instead of support.

At this point, we cannot argue that AI strengthens SOC, but considerations represent a plausible theoretical or hypothesis-generating framework for future empirical research. This third issue should gain greater theoretical and empirical attention, particularly in societies where digital technologies are deeply embedded in everyday life and health management. SOC remains a crucial resource for health promotion, while AI is an emerging tool in health care.

Aim of the work

The aim of this work is to provide an overview on the significance of strong SOC for health and to explore the emerging role of AI in health promotion and in supporting processes related to the development of SOC.

Methods

This study is a narrative review. We searched for sources on the importance of SOC and AI for maintaining and promoting health and on the role of AI in shaping SOC. For the Literature review results section, we analyzed papers published between 2023 and 2025. For the needs of the Introduction section, we limited the publication date to a period 2014-2025 in line to provide understanding background. The search was conducted in the database PubMed and in the Google Scholar web browser from September to December 2025. The following keywords and their combinations were used: “sense of coherence”, “health”, “physical health”, “mental health”, “chronic diseases”, “artificial intelligence”, and “ethics”. The Boolean Operator “AND” was applied (search strings in Supplementary Table 1). Quantitative, qualitative, primary, and secondary studies concerning SOC and AI and their connection to health were included in this review. In addition to date of publication, the filtering search criteria included freely accessible papers written in English. The initial search provided 17,396 results. Assessment of titles, keywords, abstracts, and recognition of duplicates resulted in 2,107 remining papers. Further screening provided 86 papers that were analyzed in accordance with the aim of this narrative review. Finaly, 36 articles were included in the review (Figure 1).

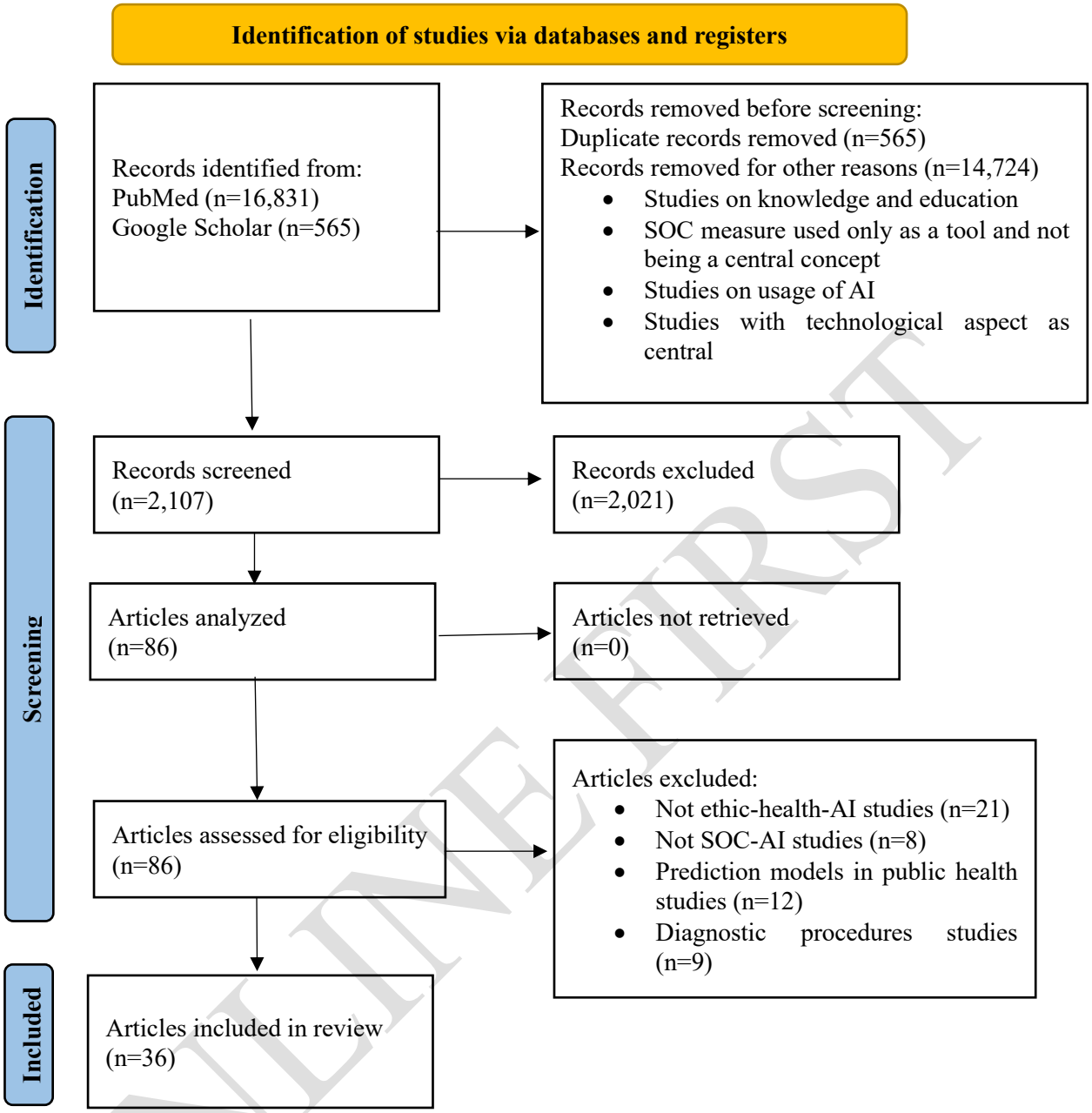

Figure 1. PRISMA 2020 flow diagram

Quality assessment

Included studies were assessed by Johanna Briggs Institute (JBI) tools (Supplementary Tables 2-8). JBI critical appraisal checklists for analytical cross-sectional, cohort, quasi-experimental and qualitative studies, systematic reviews and research syntheses, randomized controlled trials, and expert opinions were used. The studies were evaluated by two researchers (KP, LM).

Literature review results

SOC and health

SOC is a resource for achieving health [2-4], both physical and mental [8,9]. A central aspect of promoting positive mental health lies in recognizing protective factors [22,23]. Literature consistently identifies SOC as a core psychosocial resource in the maintenance and promotion of mental health. Across diverse contexts and populations, stronger SOC is associated with better psychological outcomes and functions as a protective factor against chronic and acute stressors. This is evident among caregivers of individuals with dementia, where higher SOC is linked to lower levels of burden, anxiety, and depressive symptoms [24,25]. Similar patterns are observed in occupational groups exposed to sustained psychological demands. Among young soldiers and healthcare professionals, stronger SOC is similarly associated with better mental health, suggesting that its protective role is not limited to specific types of stress exposure [22,26,27]. Recognizing the importance of SOC is a first step toward implementing SOC promoting interventions and, consequently, improving mental health outcomes [22,28]. This interpretation is further supported by research highlighting correlations between SOC and other protective resources, particularly emotional intelligence [29]. These findings suggest that SOC contributes to mental health not merely by reducing distress but by shaping how individuals perceive and respond to their environments. Accordingly, SOC-promoting interventions should be understood as important components of resilience. Individuals with stronger SOC report less hopelessness and are less likely to develop depression and anxiety, even when exposed to stress [23,30].

The relevance of SOC extends beyond occupational and caregiving contexts and appears equally important in the experience of chronic illness. Literature indicates that SOC plays a significant role in helping individuals maintain psychological well-being while coping with uncertainty, symptom burden, and treatment demands [31,32]. In oncology in particular, SOC is closely associated with patients' ability to maintain mental stability, sustain hope, and perceive challenges as manageable [33]. Studies highlight the importance of supportive consultations and a strong therapeutic alliance, suggesting that repeated and meaningful interactions with healthcare professionals may help patients identify coping resources and interpret their illness in more manageable terms [22,33]. This perspective introduces a more dynamic understanding of SOC, particularly in clinical settings, where it may be shaped and

strengthened through relational and therapeutic processes. In both cancer patients and individuals with chronic pain, stronger SOC is associated with lower levels of depressive symptoms and better psychological adjustment [33,34], indicating a consistent protective role across different illness contexts. At the same time, literature suggests that SOC may be particularly relevant because of its association with quality of life. In oncology patients, SOC has been found to correlate more strongly with quality of life than resilience or optimism [35], suggesting that it plays an important role in shaping one's perception of disease and life. Similar findings have been reported in studies of inflammatory bowel disease, where SOC is associated with better adjustment, improved disease management, and better health outcomes. In patients with Crohn's disease, stronger SOC and family support contribute to more effective disease coping and control [32,36]. In ulcerative colitis, SOC is also associated with better mental health, improved quality of life, and a more positive perception of symptoms [37]. Overall, the reviewed research indicates that SOC is relevant not only for psychological adaptation but also for disease management, coping, and health promotion. Individuals with stronger SOC tend to report lower stress in both personal and occupational settings and are more likely to engage in behaviors supporting cardiac health [38].

The described protective role of SOC can be understood through its three components: comprehensibility, manageability, and meaningfulness. Comprehensibility refers to the extent to which individuals perceive internal and external events as structured, predictable, and understandable. In the context of mental health, this dimension is particularly important in shaping how people make sense of stress, uncertainty, and illness-related disruption. Across the reviewed literature, individuals with stronger SOC are less likely to experience unpleasant situations as chaotic, incomprehensible, or psychologically disorganizing [23,30,31-37]. Manageability refers to the extent to which individuals perceive that they have sufficient resources – personal, interpersonal, or institutional – to meet life's demands. This component is reflected in studies showing that stronger SOC is associated with lower burden, anxiety, and depressive symptoms among dementia caregivers [24,25], as well as better mental health among young soldiers and healthcare professionals exposed to occupational stress [22,26,27]. Literature further indicates that manageability is importantly shaped by relational and contextual supports. Supportive consultations, therapeutic alliances, and family support all contribute to individuals' ability to identify and effectively use coping resources [22,32,33,36,37]. The third component, meaningfulness, refers to the extent to which life demands are experienced as worthy of emotional investment and engagement. Meaningfulness

helps explain why SOC is associated with lower distress, resilience, quality of life, and adaptation. Individuals with stronger SOC are more likely to remain psychologically stable rather than becoming emotionally weak [23,30]. In oncology settings, SOC has been associated with hope, emotional stability, and the ability to perceive illness as a challenge worth confronting [33,35].

AI and health

In contrast to SOC, AI exists outside the individual and can influence health as an external factor. The reviewed literature shows that AI is particularly valuable in areas where health systems face challenges related to complexity, large data volumes, and long-term care demands. In public health, AI is emphasized for its potential to support outcome prediction models and to inform intervention planning [39]. In communicable disease management, it has been associated with advances in medication development, vaccine research, and diagnostic innovation [40]. Although these fields differ, one focusing on forecasting in the population context and the other on biomedical response to disease, they both reflect a shift toward the use of predictive analytics and data management in health care. Similarly, in clinical practice, AI has been linked to improvements in diagnostics, treatment selection, and laboratory decisions, particularly because of its ability to detect patterns across large datasets with greater speed and consistency [41]. Literature consistently emphasizes that the potential benefits of AI are closely connected to questions of ethics, governance, and implementation. In this context, the adoption of the EU AI Act reflects a broader recognition that technological innovation in health care must be accompanied by clear regulatory and ethical frameworks [42]. Literature further suggests that the successful integration of AI depends on technical advancement and interdisciplinary collaboration between healthcare professionals and technology experts [20]. This is particularly relevant because many of the benefits described in literature depend on AI systems being designed and implemented in ways that are clinically meaningful, contextually designed, and responsive to users' actual needs.

The emphasis on enhanced precision and efficiency is also evident in rehabilitation and supportive care. Studies addressing telemedicine, telehealth, mobile health, virtual reality, and person-centered care suggest that AI-supported technologies have the potential to make rehabilitation and counselling more accessible, while simultaneously tailoring interventions more closely to patients' needs [43]. Compared with public health and diagnostic literature,

which often emphasizes system performance and predictive capability, rehabilitation-focused studies tend to describe AI more as a tool for active participation and skill development. In occupational therapy, for example, AI-supported interventions such as virtual reality, robotics, and natural language processing are presented as mechanisms for enhancing individuals' functional abilities and communication skills in more individualized and interactive ways [44]. Similar trends can be observed in augmented reality research, where benefits have been reported across different rehabilitation contexts, including recovery after stroke and orthopedic rehabilitation. In both groups, augmented reality is presented to support functional recovery, also influencing broader patient experiences such as motivation, pain, anxiety, and treatment engagement [45,46]. These findings suggest that AI in rehabilitation is valued for improving measurable outcomes, making care more responsive, immersive, and patient centered. Studies focused on aging, cognitive decline, and social vulnerability report similar conclusions, although in these contexts, AI is more often framed as a tool for maintaining independence and everyday functioning. In individuals with dementia, AI-based support such as medication reminders, person recognition systems, and cognitive exercises are described as mechanisms that can prolong autonomy and improve quality of life [47]. Similarly, research on loneliness and social isolation present AI less as a clinical instrument and more as a relational or social support technology. Research shows that virtual companions, assistants, and online communities can reduce feelings of isolation and facilitate social connection [48]. While literature on dementia emphasizes functional support and cognitive maintenance, and literature on loneliness emphasizes companionship and connectedness, both types of research highlight a similar role of AI: its capacity to compensate for limitations in human support systems and to provide continuity where social, cognitive, or caregiving resources may be insufficient. This role becomes particularly important in the field of mental health, where literature describes AI as a tool for improving accessibility, personalization, and early support intervention. Across studies, AI applications such as chatbots, virtual therapists, digital communities, and mental health applications are often described as valuable resources for individuals who might otherwise lack access to traditional forms of support [49-51]. Compared with rehabilitation and dementia care, where AI often supplements structured clinical pathways, mental health applications appear to occupy a more hybrid space between health care, self-management and psychosocial support. This is particularly important because such technologies may facilitate symptom monitoring or intervention delivery, reducing barriers related to stigma, offer availability and help-seeking behaviors.

The findings demonstrate that the value of AI is expressed differently across health contexts. In some areas, such as diagnostics and communicable disease management, its strengths lie in analytical power and speed [40,41]. In others, such as rehabilitation, dementia care, and mental health, its significance lies more in personalization, continuity, accessibility, and support for everyday functioning [44-51]. This distinction is important because it suggests that AI should be understood not only as a technical innovation but also as a multifunctional health resource shaped by clinical, social, and organizational context.

AI – generator of a stronger SOC?

We are living in an ageing society and also in the era of AI. Educators, innovators, experts and others should focus on empowering individuals and communities to recognize their own resources and strengths and to use them to maintain and promote health [52]. The awareness and utilization of such resources are taking place within the context of digital health and digital health care, which are redefining patient-healthcare professional relationships and the provision of care itself [53]. Our review identified no research exploring the direct association between AI and SOC. Nevertheless, based on the evidence presented above, it appears plausible that AI has considerable potential to support the development of SOC. AI provides innovative solutions that may contribute to positive change and improve quality of life for individuals facing different challenges. People are already familiar with and use AI-based systems such as chatbots, voice assistants, and social robots not only for retrieving information but also to receive individualized support in their everyday lives [50,51]. AI enables broader access to supportive settings designed to maintain and promote mental health facilitate education and provide health-related information to diverse populations. By processing vast amounts of data and identifying patterns, AI can offer personalized interventions and content that support an individual's growth and development [39,46,49,50]. With its ability to process large amounts of data and identify patterns that may be too subtle or complex for human perception, AI can function as a valuable assistant. One of its distinct advantages is that it not only increases awareness but also helps individuals consider different perspectives [49,51]. In addition, AI can support various community-based interventions aimed at promoting and maintaining health. The added value of AI in health care may be further enhanced when combined with a salutogenic perspective. The systematic use of AI tools in the context of salutogenesis represents a contemporary and holistic approach to healthcare practice [54].

Figure 2 suggests a possible model illustrating how AI might influence SOC components. AI and digital health literature is particularly relevant to salutogenic theory because many digital interventions implicitly target processes associated with the components of SOC. A notable gap in literature is that these potential mechanisms are rarely framed explicitly in the salutogenic context. Although digital interventions may support components of SOC, only a limited number of studies directly examine whether AI-based or digital health tools can strengthen SOC itself or whether changes in SOC are associated with improvements in mental health, caregiver burden, adaptation, or health-related quality of life.

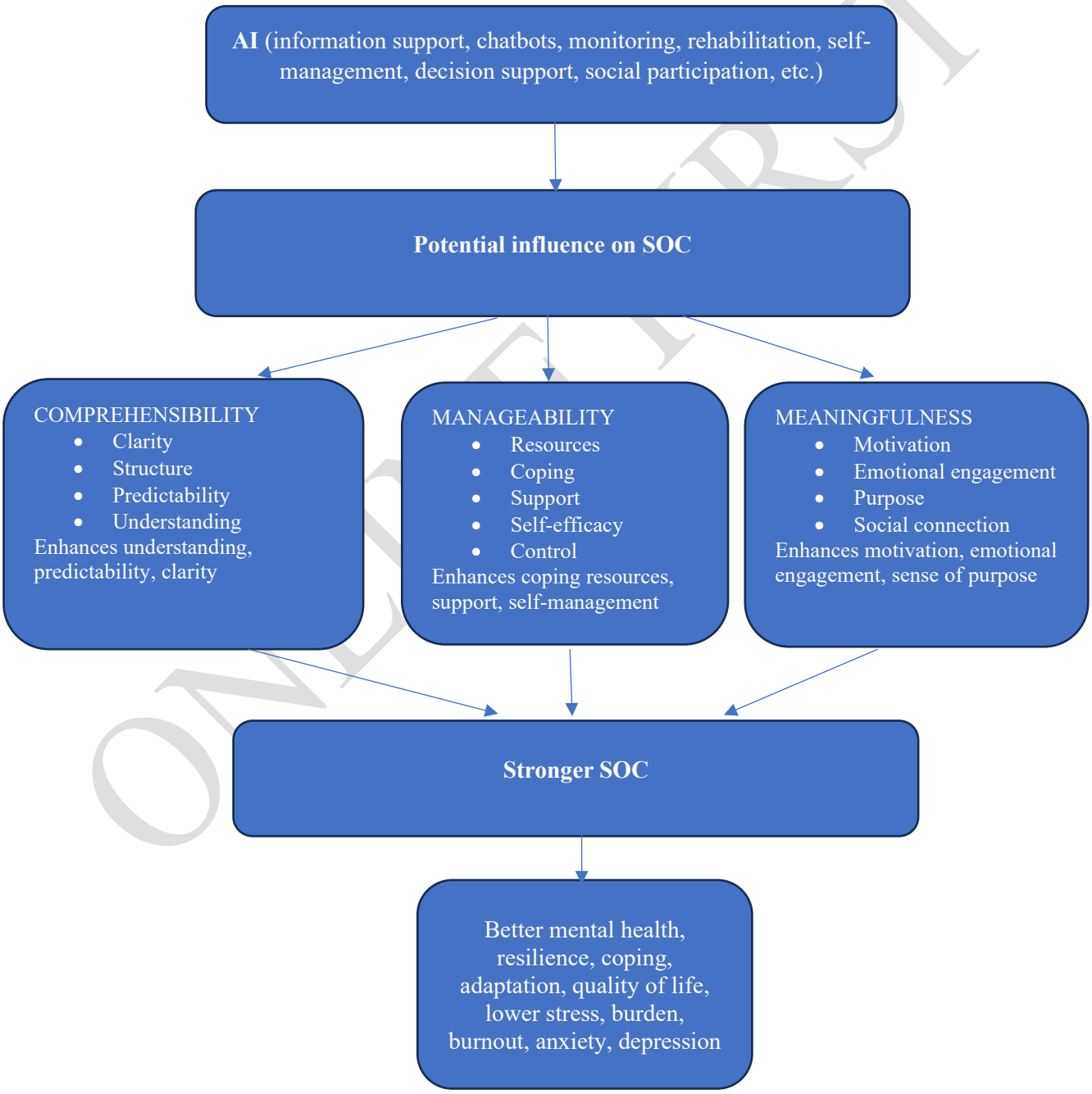

Figure 2. Model illustrating how AI might influence SOC components

The findings suggest that SOC contributes to health by reducing distress and shaping how individuals understand, respond to, and live through difficult experiences. Comprehensibility enables individuals to make sense of adversity, manageability supports the perception that challenges can be effectively addressed, and meaningfulness provides motivation and engagement. This structure is important in contemporary societies increasingly shaped by digital and AI environments. As AI becomes more deeply embedded in decision-making, self-management, communication, monitoring, and healthcare delivery, it may begin to influence the psychosocial processes through which SOC operates. AI may affect comprehensibility by shaping how health information is presented, interpreted, and trusted. It may influence manageability by expanding or constraining an individual's perceived capacity to cope through digital support, automatization, and decision assistance. It may also affect meaningfulness by shaping whether actions in the context of health are experienced as personally relevant, empowering, and worthy of engagement. From this perspective, the relevance of AI to health may extend beyond purely clinical or technical contexts. These findings again emphasize the need for further empirical research, representing a plausible theoretical or hypothesis-generating framework.

Regulatory and ethical framework

The reviewed literature demonstrates that AI in health care should not be understood merely as a technical instrument. It operates within complex systems in which outcomes are shaped by factors such as data quality, institutional priorities, clinical workflows, and user behavior [39,41]. Consequently, it is essential to establish a clear, robust, and contextually grounded regulatory framework. Because AI systems are dynamic, adaptive, and dependent on large datasets that evolve over time, regulatory approaches cannot be limited only to approval before usage. They must include continuous validation, monitoring, and final evaluation in real-world settings. This is particularly important in areas such as infectious disease modeling, diagnostic support, chatbot mental health interventions, virtual rehabilitation, and AI-supported community engagement, where algorithmic outputs may directly influence decisions in the context of health [40,45,50,54]. Literature indicates that the effectiveness of AI in health care depends on issues related to data availability and interoperability, data fragmentation, privacy, ownership, and governance [43,53].

Recent research suggests that effective management of AI in health care depends on successful integration of regulation, ethical accountability, and contextual implementation. In this context, the management of AI in health care increasingly emphasizes the issue of risk and not only ethics. Risk is particularly significant because AI systems may be exposed to clinical uncertainty, bias, data quality limitations, and accountability gaps across the process of design, deployment, and use [55,56]. Within Europe, this transition has been institutionalized through the EU AI Act, which classifies many healthcare AI applications as high-risk systems and subjects them to requirements concerning human oversight, conformity assessment, and risk management [42,57]. The reviewed literature also indicates that AI in health care should function primarily as an augmentative rather than replacement technology. AI should support healthcare professionals and users and–not replace clinical judgment, ethical reasoning, or therapeutic relationships [41,43].

Based on the reviewed literature, a responsible framework for AI in health care should:

- provide clear and evidence-based benefits to patients, professionals, or public health systems;
- minimize harm, error, inappropriate recommendations, and unintended adverse consequences;
- ensure that patients and users are informed when AI is involved and retain meaningful choice and participation in decision-making;
- promote accessibility, inclusivity, transparency, and evaluation for bias across various populations;
- preserve and support the human dimensions of health care, including empathy, trust, communication, dignity, and therapeutic relationships.

These principles are particularly relevant in emotionally, socially, and behaviorally sensitive contexts such as rehabilitation, mental health support, dementia care, and health promotion. AI should strengthen users' SOC and not create dependency, confusion, or passive reliance.

Limitations of the study

This study has several limitations that should be considered when interpreting the findings. The literature search was limited to two sources, namely PubMed and Google Scholar. Although these databases provide broad coverage of health and technology related literature,

relevant studies indexed in other databases may have been overlooked. An important limitation of this narrative review is the absence of identified studies examining the relationship between SOC, AI, and health. In addition, the inclusion criteria restricted the review to freely accessible articles published in English. This may have resulted in language bias and publication bias, as potentially relevant studies published in other languages or available only through subscription access were excluded. Another limitation relates to the publication time frame. For the Literature review results section, only studies published between 2023 and 2025 were analyzed. While this approach enabled a focus on the most recent developments in AI and SOC, it may have excluded earlier foundational studies relevant to the topic. Finally, the review included heterogeneous study designs, including quantitative, qualitative, primary, and secondary studies. Although this broad inclusion allowed for a comprehensive exploration of the topic, differences in methodological approaches and study quality may have limited the comparability and consistency of the synthesized findings.

Limitations represent an important gap in this research and provide a strong rationale for further research, particularly in populations experiencing chronic stress, caregiving burden, occupational strain, or long-term issues in the context of health.

Conclusions

This research highlights a significant and still understudied area of SOC research and digital health innovation. There is consistent evidence that SOC is associated with physical and mental health, quality of life, resilience, and the ability to cope with stress and illness. The three components of SOC are closely related to individuals' perceptions of life and consequently to their quality of life. At the same time, there is clear evidence that AI is becoming increasingly integrated into healthcare systems and services and is therefore gaining importance in health care. AI is often presented as a promising tool for improving the quality, sustainability, and accessibility of healthcare delivery. However, existing evidence regarding its capacity to provide measurable psychosocial support remains methodologically inconsistent. The proposition that AI may influence SOC is still theoretical and requires direct empirical study.

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Artificial intelligence (AI) was not used in the creation of the manuscript.

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SUPPLEMENTARY MATERIAL

Supplementary Table 1. Information sources and search strings

Information sources	Keywords	Results
Pubmed		
#1	(sense of coherence) AND (physical health)	98
#2	(sense of coherence) AND (mental health)	165
#3	(sense of coherence) and (chronic diseases)	24
#4	(artificial intelligence) AND (physical health)	3,567
#5	(artificial intelligence) AND (mental health)	3,293
#6	(artificial intelligence) AND (chronic diseases)	3,102
#7	(artificial intelligence) AND (health) AND (ethics)	6,567
#8	(health) AND (sense of coherence) AND (artificial intelligence)	5
#9	(sense of coherence) AND (artificial intelligence)	10
		16,831
Google Scholar		
#1	(sense of coherence) AND (physical health)	105
#2	(sense of coherence) AND (mental health)	166
#3	(sense of coherence) and (chronic diseases)	0
#4	(artificial intelligence) AND (physical health)	1
#5	(artificial intelligence) AND (mental health)	293
#6	(artificial intelligence) AND (chronic diseases)	0
#7	(artificial intelligence) AND (health) AND (ethics)	0
#8	(health) AND (sense of coherence) AND (artificial intelligence)	0
#9	(sense of coherence) AND (artificial intelligence)	0
		565
Total		**17,396**

Supplementary Table 2. Joanna Briggs Institute Critical Appraisal Checklist for analytical cross-sectional studies [1]

Included studies	Item 1. Were the criteria for inclusion in the sample clearly defined?			Item 2. Were the study subjects and the setting described in detail?			Item 3. Was the exposure measured in a valid and reliable way?			Item 4. Were objective, standard criteria used for measurement of the condition?			Item 5. Were confounding factors identified?			Item 6. Were strategies to deal with confounding factors stated?			Item 7. Were the outcomes measured in a valid and reliable way?			Item 8. Was appropriate statistical analysis used?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
22	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
23	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
25	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
26	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
27	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
28	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
30	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
31	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	NA	**Y**	NA	NA	**Y**
32	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
33	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	U	U	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
35	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
36	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
37	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
47	Y	Y	**Y**	Y	Y	**Y**	U	Y	**Y**	Y	U	**Y**	U	U	**Y**	U	U	**Y**	Y	NA	**Y**	Y	NA	**Y**
50	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	U	U	**Y**	U	U	**Y**	Y	NA	**Y**	Y	NA	**Y**

Notes: C: Consensus; NA: not applicable; R^1: Rater 1; R^2: Rater 2; U: unclear; Y: yes.

Supplementary Table 3. Joanna Briggs Institute Critical Appraisal Checklist for cohort studies [2]

Included Studies	Item 1. Were the two groups similar and recruited from the same population?			Item 2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?			Item 3. Was the exposure measured in a valid and reliable way?			Item 4. Were confounding factors identified?			Item 5. Were strategies to deal with confounding factors stated?			Item 6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?			Item 7. Were the outcomes measured in a valid and reliable way?			Item 8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?			Item 9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?		
	R1	R2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
24	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	U	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	U	**Y**	U	Y	**Y**
38	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	Y	**Y**

Included Studies	Item 10. Were strategies to address incomplete follow up utilized?			Item 11. Was appropriate statistical analysis used?		
	R^1	R^2	C	R^1	R^2	C
24	U	U	**Y**	Y	Y	**Y**
38	U	U	**Y**	Y	Y	**Y**

Notes: C: Consensus; R^1: Rater 1; R^2: Rater 2; U: unclear; Y: yes.

Supplementary Table 4. Joanna Briggs Institute Critical Appraisal Checklist for systematic reviews and research syntheses [3]

Included Studies	Item 1. Is the review question clearly and explicitly stated?			Item 2. Were the inclusion criteria appropriate for the review question?			Item 3. Was the search strategy appropriate?			Item 4. Were the sources and resources used to search for studies adequate?			Item 5. Were the criteria for appraising studies appropriate?			Item 6. Was critical appraisal conducted by two or more reviewers independently?			Item 7. Were there methods to minimize errors in data extraction?			Item 8. Were the methods used to combine studies appropriate?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
29	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	NA	NA	**Y**
34	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	U	U	**Y**	U	U	**Y**	Y	Y	**Y**
45	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
53	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	U	U	**Y**	Y	Y	**Y**	NA	NA	**Y**
55	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	U	U	**Y**	U	U	**Y**	Y	Y	**Y**
56	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	NA	NA	**Y**

Included Studies	Item 9. Was the likelihood of publication bias assessed?			Item 10. Were recommendations for policy and/or practice supported by the reported data?			Item 11. Were the specific directives for new research appropriate?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
29	NA	NA	**Y**	NA	NA	**Y**	NA	NA	**Y**
34	U	U	**Y**	Y	N	**Y**	Y	U	**Y**
45	Y	Y	**Y**	Y	N	**Y**	Y	N	**Y**
53	NA	NA	**Y**	NA	NA	**Y**	NA	NA	**Y**
55	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**
56	NA	NA	**Y**	NA	NA	**Y**	NA	NA	**Y**

Notes: C: Consensus; NA: not applicable; N: no; R^1: Rater 1; R^2: Rater 2; U: unclear; Y: yes.

Supplementary Table 5. Joanna Briggs Institute Critical Appraisal Checklist for randomized controlled trials (RCTs) [4]

Included studies	Item 1. Was true randomization used for assignment of participants to treatment groups?			Item 2. Was allocation to treatment groups concealed?			Item 3. Were treatment groups similar at the baseline?			Item 4. Were participants blind to treatment assignment?			Item 5. Were those delivering the treatment blind to treatment assignment?			Item 6. Were treatment groups treated identically other than the intervention of interest?			Item 7. Were outcome assessors blind to treatment assignment?			Item 8. Were outcomes measured in the same way for treatment groups?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
51	Y	Y	**Y**	U	Y	**Y**	Y	Y	**Y**	N	Y	**Y**	N	NA	**Y**	U	NA	**Y**	Y	Y	**Y**	U	Y	**Y**

Included studies	Item 9. Were outcomes measured in a reliable way?			Item 10. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?			Item 11. Were participants analysed in the groups to which they were randomized?			Item 12. Was appropriate statistical analysis used?			Item 13. Was the trial design appropriate and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
51	Y	Y	**Y**	Y	N	**Y**	Y	N	**Y**	Y	Y	**Y**	Y	Y	**Y**

Notes: C: Consensus; N: no; NA: not applicable; R^1: Rater 1; R^2: Rater 2; U: unclear; Y: yes.

Supplementary Table 6. Joanna Briggs Institute Critical Appraisal Checklist for quasi-experimental studies [5]

Included studies	Item 1. Is it clear in the study what is the "cause" and what is the "effect" (i.e. there is no confusion about which variable comes first)?			Item 2. Was there a control group?			Item 3. Were participants included in any comparisons similar?			Item 4. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?			Item 5. Were there multiple measurements of the outcome, both pre and post the intervention/exposure?			Item 6. Were the outcomes of participants included in any comparisons measured in the same way?			Item 7. Were outcomes measured in a reliable way?			Item 8. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
49	Y	Y	**Y**	U	Y	**Y**	U	Y	**Y**	U	Y	**Y**	Y	U	**Y**	U	NA	**Y**	Y	Y	**Y**	Y	Y	**Y**

Included studies	Item 9. Was appropriate statistical analysis used?		
	R^1	R^2	C
49	Y	U	**Y**

Notes: C: Consensus; NA: not applicable; R^1: Rater 1; R^2: Rater 2; U: unclear; Y: yes.

Supplementary Table 7. Joanna Briggs Institute Critical Appraisal Checklist for qualitative research [6]

Included studies	Item 1. Is there congruity between the stated philosophical perspective and the research methodology?			Item 2. Is there congruity between the research methodology and the research question or objectives?			Item 3. Is there congruity between the research methodology and the methods used to collect data?			Item 4. Is there congruity between the research methodology and the representation and analysis of data?			Item 5. Is there congruity between the research methodology and the interpretation of results?			Item 6. Is there a statement locating the researcher culturally or theoretically?			Item 7. Is the influence of the researcher on the research, and vice- versa, addressed?			Item 8. Are participants, and their voices, adequately represented?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
54	U	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	U	U	**Y**	U	Y	**Y**	Y	Y	**Y**

Included studies	Item 9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?			Item 10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?		
	R^1	R^2	C	R^1	R^2	C
54	Y	Y	**Y**	Y	U	**Y**

Notes: C: Consensus; R^1: Rater 1; R^2: Rater 2; U: unclear; Y: yes.

Supplementary Table 8. Joanna Briggs Institute Critical Appraisal Checklist for for textual evidence: expert opinion [7]

Included studies	Item 1. Is the source of the opinion clearly identified?			Item 2. Does the source of opinion have standing in the field of expertise?			Item 3. Are the interests of the relevant population the central focus of the opinion?			Item 4. Does the opinion demonstrate a logically defended argument to support the conclusions drawn?			Item 5. Is there reference to the extant literature?			Item 6. Is any incongruence with the literature/sources logically defended?		
	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C	R^1	R^2	C
52	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**
39	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**
40	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	Y	**Y**
41	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	Y	**Y**
42	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	U	**Y**
43	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**
44	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**
46	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	Y	**Y**
48	Y	Y	**Y**	U	U	**Y**	Y	Y	**Y**	Y	U	**Y**	Y	Y	**Y**	U	Y	**Y**
57	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	Y	Y	**Y**	U	U	**Y**

Notes: C: Consensus; R^1: Rater 1; R^2: Rater 2; U: unclear; Y: yes.

References:

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