Arch Psychiatry. 2024;2(1):6-19.

The Archives of Psychiatry | Research Article

A Narrative Development Process to Enhance Mental Health Considering Recent Hippocampus Research

Carol Nash[1,*]

[1]History of Medicine Program, Department of Psychiatry, Temerty Faculty of Medicine, University of Toronto, Toronto, ON M5S 1A1, Canada

[*]Correspondence should be addressed to Carol Nash, carol.nash@utoronto.ca

Received date: November 08, 2023, **Accepted date:** January 12, 2024

Citation: Nash C. A Narrative Development Process to Enhance Mental Health Considering Recent Hippocampus Research. Arch Psychiatry. 2024;2(1):6-19.

Abstract

Narrative development is fundamental to human mental health. Interventions providing individuals with the means to construct and recall robust and effective narratives are necessary in promoting positive mental health outcomes. The primary embodied location of personal narrative development is the hippocampus. Recent advances regarding the relationship among the hippocampus, narrative, and mental health are thus relevant concerning the hippocampal mechanisms that simultaneously function to map environmental position and to generate episodic memories. Consequently, this study considers the role of the hippocampus with a limited, six-database review of "hippocampus, narrative, mental health" that located 127 records, and included 14 reports for study. The results support creating and maintaining stable and coherent narratives as fundamental to human mental health. Without this, people distort facts in their personal accounts, their body functions are disrupted, and their DNA becomes altered (critical to cancer formation and development) in the effort to sustain these personal narratives. As such, narrative construction is found to lead to negative mental health in a variety of ways unless positively developed in a manner compatible with identified hippocampal functions. One intervention proven successful in enhancing robust and effective narratives that are stable and coherent is the Health Narratives Research Process developed for those researchers self-identifying as experiencing burnout. This process is outlined, and its most recent results presented, demonstrating not only improved mental health but doing so in support of identified hippocampal function—offering the opportunity for future research regarding the relationship among narrative development, mental health, and the hippocampus.

Keywords: Narrative, Mental health, Interventions, Environmental position, Episodic memories, Hippocampus, Personal accounts, Burnout

Introduction

Narrative development is fundamental to human mental health and represents personal identity [1] to the extent that it takes highly toxic substances to erase well-consolidated narrative memories through disrupting hippocampal function [2]. It has been demonstrated there is a direct relationship among the hippocampus, narrative, and mental health such that developing a robust and effective personal narrative creates enhanced changes in the hippocampus [3] and can support mental health recovery through reframing and developing a more positive identity [4]. In all, the workings related to the hippocampus in humans represent the narrative governing their personal choices [5]. It is in this way that the ability to create a stable and coherent narrative largely identifies the mental health of individuals [6].

A number of ground-breaking advances in theory and methodology regarding the hippocampus have changed what is understood regarding the structure and function of the hippocampus as well as the study of memory. These developments include new insights into the molecular and cellular structure of this brain region as well as its physiology. Regarding memory, the role of the hippocampus in forming, consolidating, enhancing, and retrieving memories permits investigations into how the hippocampus interacts with other neural systems involving memory—functionally and anatomically [7]. The specific relationship of the hippocampus

to narrative includes the finding that narratives developed in relation to stress (with burnout representing one type of stress) not only change the hippocampus itself, but do so by altering DNA—a problem especially evident concerning depression [8]. Changes to DNA resulting in its damage is well recognized as a critical factor in cancer development and progression [9].

The aim of this study is to present a narrative research process founded and facilitated by the author. It is one specifically intended for health researchers experiencing burnout and represents an example of a process that has been identified as useful in enhancing personal narrative development leading to positive mental health outcomes in well-defined conditions. As a public health intervention with an explicit theory regarding how a course of action will solve a particular problem [10], this intervention, intended to support self-management regarding burnout [11], is the Health Narratives Research Process.

This study presents research conducted recently regarding the hippocampus in connection with narrative and mental health. The result will be investigated as background to determine the extent of the relationships among them. To accomplish this, six databases—five primary (OVID, PubMed, ProQuest, Scopus, Web of Science), and one supplementary (Google Scholar)—were searched on 17 August 2023 in a limited review of "hippocampus, narrative, mental health" for peer reviewed articles published from 2019 to the present. The review was confined to the last five years to follow best practices for reviews in health-related fields [12]. Only those concerning humans were included. The result is that research published during this period reinforced that the hippocampus is the location of memories regarding environmental position while simultaneously generating episodic memories, although the mechanisms underlying the formation and management of the memory traces remain poorly understood [13].

Beyond this review of recent hippocampal research, improving the mental health of individuals is identified as effectively (though not easily) accomplished through focusing on enhancing personal narrative development [14-17]. In this regard, this study will summarize and examine the Health Narratives Research Process (with materials and methods that have been well-documented in previous publications [16,18-21]) in the Discussion as one such intervention that has accomplished enhancing personal narrative development in those self-identifying as experiencing burnout.

This study is valuable because (1) it is the first to examine narrative development and mental health in relation to the workings of the hippocampus through assessing the mechanisms of the hippocampus that simultaneously function to map environmental position and to generate episodic memories in humans, and (2) it presents and discusses a narrative development intervention process that has the potential to positively alter hippocampal function and improve mental health in those self-identifying as experiencing burnout.

Materials and Methods

Study design

A limited review was undertaken of a parameter with the keywords "hippocampus, narrative, mental health" to understand the range of information available connecting the hippocampus with narrative and mental health. The methods used in gathering the materials utilized the most recent template of the preferred reporting items for the systematic review and meta-analyses (PRISMA) flow of information diagram specific to scoping reviews [22]. Although not a true scoping review [23] (because the keywords searched were not extensive enough to make the search comprehensive), along with the **Figure 1** flowchart, a 2020 PRISMA Scoping Review Checklist [22] was completed as **Supplementary Table (S1)**, detailing the page location where each aspect of the process is reported for this study. The author chose to follow the PRISMA process for scoping reviews as it has been assessed as a high-level procedure [24]. Each of the methods followed is recorded in **Figure 1**. Six databases were searched, including five primary databases (OVID, PubMed, ProQuest, Scopus, Web of Science), and one supplementary database (Google Scholar). All searches were performed 17 August 2023 by the author.

Searched records returned

The OVID search included the following databases: Embase, APA Psychinfo, and Medline. This search was narrowed in the following ways: "published between 2019-2024," "APA PsycArticles Journals," "English language," "humans," "human," "peer reviewed." For this OVID search, there were nine returns. Of the returns, one was a duplicate, six included the keyword "narrative" only in relation to the article in question being a narrative review (and were therefore inappropriate for inclusion), one was lacking the keyword "hippocampus" in the text (it was found only in the references), leaving one return that was included for review.

The search of PubMed that followed was able to include a "not" qualifier (this was not found possible with the OVID search). As such, the keywords searched were "hippocampus, narrative, mental health, not narrative review." There were no returns retrieved.

For the ProQuest search, undertaken after the PubMed search, the same keywords were used as in the PubMed search. The returns were qualified to: "English," "published between 2019-2024," "scholarly journals," and "articles." There were five returns. Of these, two did not include mental health.

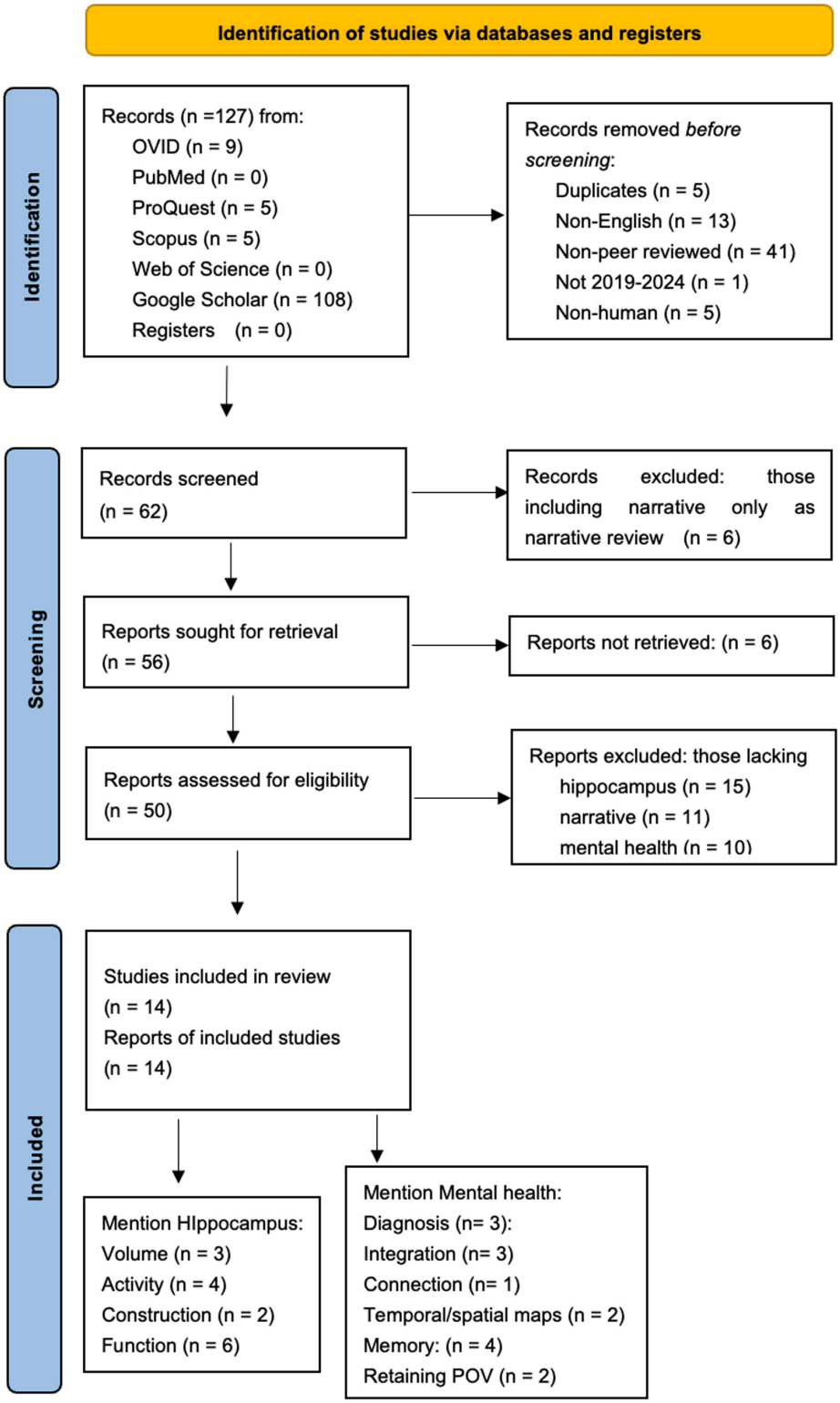

Figure 1. The preferred reporting items for systematic review and meta-analyses (PRISMA) flow of information chart (Page et al. 2021 [22]) for a scoping review followed for a limited review of a search of the parameter with the keywords, "hippocampus, narrative, mental health" in the following databases: OVID, PubMed, ProQuest, Scopus, Web of Science, and Google Scholar conducted on 17 August 2023. No registers were searched.

Accordingly, three were included for review.

For the Scopus search that followed, there were five returns using the same search process as for ProQuest. "Narrative" was not found in one of the returns, and "mental health" was not present in three. There was one article included for review.

The Web of Science search of "hippocampus, narrative, mental health, not narrative review" produced no returns.

A search of Google Scholar for articles published between 2019-2024 produced 108 returns. There were four duplicates, 13 not in English, 41 that were not peer reviewed, one not published between 2019-2024, and five non-human. This left 44 records to be screened of the Google Scholar search and 62 records to be screened in total, including those from the other database searches. There were zero records excluded because they mentioned narrative only in relation to the publication representing a narrative review, leaving 44 Google Scholar reports sought for retrieval (56 in total, combining all searches performed that day). Of these reports, six from the Google Scholar search were unable to be retrieved, leaving 39 of these reports and 50 in total. The Google Scholar reports assessed for eligibility excluded reports lacking the following keywords: "hippocampus"—14; "narrative"—10; "mental health"—5. This left nine studies from the Google Scholar search included in the review, equaling 14 studies in total included.

Regarding the Google Scholar search: although five records were excluded for not including "mental health," all of the records included used a synonym for "mental health," and not the exact phrase. Given that the purpose of the search was to include those papers that discussed mental health, not the exact wording "mental health," these articles were accepted to be included. However, lacking "mental health" is likely the reason these works were not located in any of the other searches performed permitting more advanced searching. The terms used in the reports returned of the Google Scholar search that were considered equivalent to mental health (given the context in which they appeared) are: "mental stimulation," "mental state," "mental disorders," "mental files," "mental strength,""mental stress,""mental representation," and "mentalization functions."

It is noted in **Figure 1** that there were no registers searched.

Searched records included

A distinction was made between how the hippocampus was mentioned in the 14 reports included and the focus on mental health for those reports of included studies. In contrast, there was no greater separation made for narrative (as the other keyword searched)—defined as a personally valued creation with a beginning, middle and end [25] (p.26). This was because its mention in each article was to describe the process of creating a personal story. As seen in **Figure 1**, the mentions of the hippocampus and those of mental health total to 15 although there were only 14 reports included. This is because one report in each case mentioned more than one way of considering either the hippocampus or mental health.

The mentions of the hippocampus were divided into the following categories: volume—3; activity—4; construction—2; and function—6. The same 14 returns were also classified regarding mental health: diagnosis—3; integration—3; connection—1; temporal/spatial maps—2; memory—4; and point of view—2. These divisions are recorded in **Table 1** and are reported in detail in the Results section to follow.

Table 1. Citation numbers, authors, and publication dates of 14 reports included from a 17 August 2023 search of the parameter containing the keywords "hippocampus, narrative, mental health". These are listed in order of their return in searching the following databases: OVID—1; ProQuest—3; Scopus—1; Google Scholar—9. The hippocampal focus in developing personal narratives and effect regarding mental health are specified for each.

Cit. #	Authors, Publication Date	Hippocampal Focus	Effect Regarding Mental Health
26	Dee., et al., 2023	Volume decreased	DNA altered from early childhood trauma
27	Siegel & Drulis, 2023	Decreased activity	Impaired functional & structural integration
28	Traynor, et al., 2023	Decreased rs-fMRI activity	Connectivity, self-interpersonal impairment
29	Raver & McElheran, 2022	Decreased volume & activity	Limited processing of mental events
30	Magni et al., 2019	Decreased volume	Clinical priority regarding BPD
31	Kelly & O'Connell, 2020	Storied visualization	Connectivity: pivotal role in morality
32	Larner, 2022	Semantic retrieval	Time/space confusion separate
33	Stoyanov, et. al., 2019	Highest peaks fMRI	Cross-validation: depression, paranoia
34	Thorpe, 2022	"Concept cells"	Cognitive spatial & temporal maps
35	Pine, 2022	Leptin signaling	Health related to memory of food

36	Michelmann, et al., 2022	Memory replay	Contracted temporal order of things
37	Sriyanah, et. al., 2022	High cortisol	Memory consolidation chaotic, longer REM
38	Yazin, et al., 2021	Contextual binding	Dual nature to episodic memory recall
39	Kirsch, et al., 2021	Lesions	Associated with learned counterfactual beliefs

Results

The 14 reports included are found in **Table 1**. They are listed here by title with respect to the databases searched in order of their return:

OVID—Epigenetic changes associated with different types of stressors and suicide (Dee, et al., 2023) [26].

ProQuest—An interpersonal neurobiology perspective on the mind and mental health: personal, public, and planetary well-being (Siegel & Drulis, 2023) [27]; Dimensional personality impairment is associated with disruptions in intrinsic intralimbic functional connectivity (Traynor, et at., 2023) [28]; A trauma-informed approach is needed to reduce police misconduct [29].

Scopus—Neurobiological and clinical effect of metacognitive interpersonal therapy vs structured clinical model: study protocol for a randomized controlled trial (Magni et al., 2019) [30].

Google Scholar—Can neuroscience change the way we view morality? (Kelly & O'Connell, 2020) [31]; Investigation of TGA (1): Neuropsychology, neurophysiology and other investigations (Larner, 2022) [32]; Cross-validation of functional MRI and paranoid-depressive scale: Results from multivariate analysis (Stoyanov, et. al., 2019) [33]; Atomic event concepts in perception, action, and belief (Thorpe, 2022) [34]; Food memory and food imagination at Auschwitz (Pine, 2022) [35]; Speed of time-compressed forward replay flexibly changes in human episodic memory (Michelmann, et al., 2022) [36]; Relationship between hospitalization stress and changes in sleep patterns in children aged 3-6 years in the Al-Fajar Room of Haji Hospital, Makassar (Sriyanah, et. al., 2022) [37]; Contextual prediction errors reorganize naturalistic episodic memories in time (Yazin, et al., 2021) [38]; and Updating beliefs beyond the here-and-now: the counter-factual self in anosognosia for hemiplegia (Kirsch, et al., 2021) [39] (see **Table 1**).

The search results of "hippocampus, narrative, mental health" returned titles that represent a wide variety of studies in various disciplines—some scientific and others humanities-based. The topics are diverse. All that connects them is their common search terms. It can be gleaned from this type of result that the relationship among these three search terms is far-ranging and involves many forms of scholarship. The details of these results to follow divide them broadly into the types of mention of the hippocampus and then the types of mention of mental health. As in each case narrative is understood to relate to a personal perspective on constructed stories, there is no accompanying discussion of types of mention of narrative as narrative is understood by each returned title in the same manner.

Types of mention of the hippocampus

With respect to the Hippocampus, there are three studies that report on hippocampal volume—each regarding a decrease in volume [26,29,30]. The decrease in volume was determined post-mortem in one [26]. Functional magnetic resonance imaging (fMRI) was used to measure the volume of the hippocampus in the other two [29,30].

Activity in the hippocampus is a concern of four of the studies—two regarding a decrease in hippocampal activity [27,29], without information provided in how this decrease was measured, and two concerning an increase in fMRI used to observe activity [28,33].

The actual construction of the hippocampus is the focus of two of the articles—one in healthy individuals [34], measured in comparison with language construction, and one regarding patients with lesions [39] using voxel-based lesion symptom mapping.

The remaining six papers concentrate on the function the hippocampus was investigated to perform—[31,32,35-38]. The first measures visualization through brain activity [31]. The second article refers to research using PET scans to measure 3D space navigation [32]. The third relies on earlier research administration of the adiposity hormone leptin to the dorsal and ventral sub-regions of the hippocampus [35]. The fourth, regarding sequential ordering, used an external measure of actual movement in space, relying on earlier research to demonstrate the hippocampal outcome [36]. The fifth concerns the sleep patterns of young children—an article in which it is unstated how changes in the hippocampus were measured [37]. The sixth and final paper discussed the contextual and predictive functions of the hippocampus, again using as an external measure to test this function [38].

Volume. Of the 14 reports included for study, three focused on the results of a decreased change in the volume of the hippocampus [26,29,30]. One showed that trauma narratives correspond with a reduction in hippocampal volume [26] while the two others reported that reduced volume in the hippocampus is related to bipolar disorder [29,30]—especially when narrativizing their experiences was not available to those studied.

The first study represents a review of current literature on epigenetic changes associated with different types of stressors as well as suicide [26]. The few studies specific to the hippocampus that concern humans are primarily post-mortem studies of suicides. An exception is a study of 33 adults with major depressive disorder matched with 36 healthy adults. The findings were that childhood trauma narratives, being male, and smaller hippocampal volume were independently associated with greater peripheral serotonin transporter methylation, altering the DNA in these cases.

The second article reports on the need for a trauma-informed approach to reduce police misconduct [29]. The findings referenced are that chronic exposure to potentially psychologically traumatic events, combined with limited opportunities to process events emotionally, physically, and cognitively through narrative, can influence neuroanatomic structural changes in the brain, including reduced volume in the hippocampus.

The third report returned that focuses on change in the volume of the hippocampus is a study protocol for a randomized controlled trial of the neurobiological and clinical effect of metacognitive interpersonal therapy compared with a structured clinical model [30]. As such, the role of the hippocampus in relation to narrative development represents only a small aspect of the study, with the authors' referencing that several MRI studies explored the neurobiological correlates of bipolar disorder and these showed volume reduction in the hippocampus, among their other findings.

Activity. There were 4 articles included that mentioned the activity of the hippocampus—two concerning decreased activity [27,29], and two related to an increase in hippocampal activity visible through fMRI used to observe the activity [28,33]. The papers specifying decreased activity will be discussed first, followed by the those mentioning increased fMRI imagining activity.

The 2023 paper regarding an interpersonal neurobiology perspective on the mind and mental health with respect to personal, public, and planetary well-being [27] notes that individuals with a range of conditions, such as those with schizophrenia, bipolar disorder, autism spectrum disorder, and post-traumatic stress disorder, have impaired functional and structural integration regarding narrative developed, revealed especially in regions such as the hippocampus, where there is decreased activity.

The article on the need for a trauma-informed approach to reduce police misconduct was already noted in the previous subsection on Volume [29]. It specifies that activity in the hippocampus is also reduced with chronic exposure to potentially psychologically traumatic events. These must be combined with limited narrativizing opportunities to process events emotionally, physically, and cognitively to influence neuroanatomic structural changes to result in reduced activity in the hippocampus.

Resting state (rs)-fMRI is identified as a powerful method to investigate neuroimaging biomarkers of psychiatric illness, such as personality disorder with respect to narrative in a study of dimensional personality impairment [28]—the focus of these authors' article. An increase in rs-fMRI notes changes to, among other parts of the brain, the anterior parahippocampal gyrus, and to the hippocampus itself. For this research, there were 45 participants in the personality disorder group and 29 for the control group.

The stimuli represent items from a paranoid-depressive self-evaluation scale, administered simultaneously with fMRI, for a study of the cross-validation of fMRI and paranoid-depressive scale, concerning the results from multivariate analysis [33]. The results found that among the highest peaks in activity were those associated with the hippocampus for both narrativizations regarding those diagnosed with schizophrenia and depression. Included in the study were 30 adult psychiatric patients with either a diagnosis of schizophrenia (n = 16, mean age 36.4 ± 12.5 y, 10 males), or depressive episode (n = 14, mean age 45.3 ± 12.5 y, five males).

Construction. The specific construction of the hippocampus is the focus of two of the reports included—one in healthy individuals [34], and one concerning patients with lesions [39].

A paper published in 2021 about atomic event concepts in perception, action, and belief that produce narrative [34], claims there is empirical evidence for the existence of internal cognitive spatial and temporal maps in the hippocampus and that their neural implementation is identified as residing in the hippocampus. Furthermore, the authors note there is evidence that 'concept cells' are also located in the hippocampus, playing a critical role in the formation of when-beliefs and where-beliefs, necessary in the construction of narrative.

An article regarding the counter-factual self in anosognosia for hemiplegia [39] looked specifically at patients with lesions. It was found that learned counterfactual beliefs producing ineffective narratives were associated with lesions in the limbic regions for the 26 patients with right hemisphere stroke studied. The hippocampus was among those areas where lesions produced this result.

Function. There were 6 papers that concentrated on hippocampal function [31,32,35-38]. These will be examined in order of their citation number.

Whether neuroscience can change the way morality is viewed [31] is the topic of a paper that states stories activate a broad array of brain areas that support language, emotion, memory, and imagination, with the hippocampus primary among those areas. The most important role of the hippocampus in this regard is found to be visualization.

In an investigation of Transient Global Amnesia (TGA), a sudden syndrome of anterograde and shrinking retrograde memory loss lasting several hours in otherwise healthy adults [32], the authors found impaired semantic fluency in 16 patients during TGA, compared to their function one day later, suggesting a role for the hippocampus in semantic retrieval in narrative construction. Furthermore, this article also notes that sophisticated tests of hippocampal function have recognized selective and prolonged deficits in hippocampus-dependent spatial navigation in patients following TGA, intimating damage within the hippocampus [40].

Food memory and food imagination at Auschwitz [35] identifies that, when active, the hippocampus receives and responds to appetite signals, like the hormone leptin, as the hippocampus has a direct link to the digestive system that goes beyond emotion and smell. As a result, in situations where individuals are deprived of food—such as prisoners of the concentration camp Auschwitz during World War II—they can lose their memory for food affecting their narrative regarding food. In the case of many of these liberated prisoners, this loss of food memory coincided with an inability of leptin to signal food intake to the hippocampus, resulting in death of these liberated prisoners.

An article investigating speed of time-compressed forward replay flexibly changes in human episodic memory [36] finds that it is possible for memory replay in humans to be forward and compressed such that the duration of memory replay or mental navigation is found to be faster than the real navigation, but this varies substantially between participants. Here, hippocampal place cells, corresponding to certain positions in the navigational path, later fire again on a faster timescale than during navigation. In this regard, narrative and actuality do not coincide.

Investigating the relationship between hospitalization stress and changes in sleep patterns in children aged 3-6 years in Indonesia [37] found, in a sample size of 45 children using accidental sampling, that 83.3% experienced changes in sleep patterns coinciding with the changes in narrative they construct regarding sleep. The authors conclude that the higher the hospitalization stress preschool-aged children experience, the more their sleep patterns tended to change, and that the higher the cortisol produced, the higher the disturbances in the hippocampal and neocortical systems.

It is recognized in a paper concerning how contextual prediction errors reorganize naturalistic episodic memories in time [38] that in daily life multiple different events share the same context—the example is given of children exposed to different subjects in online learning where their memory encoding is in the same context. It is proposed by the authors that contextual binding is a unified mechanism of narrative with the hippocampus playing a central role in item and context binding, where the hippocampus is sensitive to predictive mismatches [41].

Types of mention of the mental health

There are three papers that report on at least one specific mental diagnosis [26,30,33], while three are specifically concerned with structural integration regarding mental health [27,29,37], and one focuses on connection of brain activity [29]. The development of temporal/spatial mental maps is the concentration of two articles [34,36]; memory is highlighted in four studies [32,35,37,38]; and the ability to assume a particular point of view is examined in two publications [31,39]. The studies reported below are the same as those noted in the previous subsection regarding their information concerning the hippocampus, now examined regarding their mention of mental health.

Diagnosis. Mental health is examined in relation to the diagnosis of suicidality in the article regarding epigenetic changes associated with different types of stressors and suicide [26]. Various studies have provided evidence that stress exposure of different types—especially as a result of narratives related to childhood trauma—and the associated epigenetic changes linked to maladaptive and poor mental health outcomes concerning suicide completers, and can be passed down through generations through changes in the DNA [42-44].

A study protocol for a randomized controlled trial focused on borderline personality disorder [30] in considering the neurobiological and clinical effect of metacognitive interpersonal therapy versus a structured clinical model. The population the focus of study represents is a clinical priority of the Italian mental health system because of its high suicidal risk, high direct and indirect health costs, long-term impairment, and social dysfunction associated with borderline personality disorder. Therefore, the need for effective person narratives in this population is considered a high priority.

The results of a multivariate analysis were in regard to those diagnosed with paranoia and/or depression [33]. The purpose of the study was to cross-validate fMRI results. The study confirmed the possibility to achieve bottom-up classification of mental disorders through this method of cross-validation by use of the brain signatures relevant to clinical evaluation tests. These brain signatures correspond to the narrativization developed by these patients.

Integration. The first article to discuss structural integration with respect to mental health offers an interpersonal neurobiology perspective on the mind and mental health, specifically in relation to personal, public, and planetary well-being [27]. The article outlines an interpersonal neurobiology perspective regarding the fundamental components of mental health that promote well-being. The primary contention of these authors is that mental health is generally defined as a

lack of mental illness rather than optimal self-organization through narrative integration, promotion of mental health, and the recognized need for resilience. There is impaired functionality and a lack of structural integration without this type of optimal self-organization through narrative.

In a paper investigating a trauma-informed approach to reduce police misconduct it is argued that police misconduct is the result of a high level of mental health problems in police officers stemming from their identified neurobiological dysregulation and subsequent poor decision making while under threat [29]. This is seen to result from a limited ability to process mental events through narrative development resulting from coercion to assimilate into an entrenched police culture reinforced by organizational stressors.

The examination of the relationship between hospital stress and changes in sleep patterns in pre-school-aged children for one hospital in Indonesia [37] finds poor mental health. This is the result of the disrupted sleep of these children during hospitalization found to be caused by narratives developed based on fear, worry, and anxiety, leading to disintegrating mental stress and chaotic memory consolidation concurrent with longer REM sleep.

Connection. One article focuses on personality disorder [28] and concludes that disruptions in both core mentalization and affective networks are present in personality disorder, causing impairment in connectivity and self-interpersonal relationships that produce narrative. Furthermore, higher intralimbic functional connectivity may represent what underlies self-interpersonal personality impairment in personality disorder regardless of the specific symptoms. This is seen to provide initial neurobiological evidence to support alternative dimensional conceptualizations of personality disorders.

Temporal/spatial maps. Mental health is related to understanding concepts as mental files [34] in an article concerned with atomic event concepts in perception, action and belief. These files have an extension, are used to store information, and have a reliable but fallible way of recognizing instances of a concept in creating narrative. In the view of the study's author, these mental files play a role in background deliberation and planning as, without them, there is insufficient time for deliberation and planning. As such, mental files contain simple instructions and links to motor plans, representing cognitive spatial and temporal maps.

An article looking at the speed of time-compressed forward replay flexibility changes in human episodic memory [36] considers mental episodes as they relate to narrative. These are seen to be contracted from that of original perception, yet they are longer episodes of the time participants take to mentally simulate a path that increases when the path of this episode includes more turns.

Memory. In a paper focusing on transient global amnesia [32], a sudden, temporary interruption of short-term memory causing disorientation in patients resulting in confusion regarding their perceived location in space and time (although otherwise alert, attentive and normal in their thinking abilities) the author indicates that various cognitive screening devises return their scores as normal, providing a reference for an in depth discussion of these tests in this regard [45]. This result confirms that this type of space/time confusion in creating narrative is separate from the thinking abilities tested.

Once liberated, concentration camp prisoners who had suffered severe malnutrition experienced new physical and mental health disorders caused by an inability to digest food appropriately as their food memory had been negatively affected. This is explained in food memory and food imagination at Auschwitz [35]. Without this food memory creating appropriate narratives related to food, such liberated prisoners were unable to regain the ability to eat productively and, as a result, died of malnutrition.

A problem with memory consolidation in creating narratives affected by fear and anxiety is the mental health difficulty displayed by preschool-aged children confined to a hospital [37]. This is the result of disrupted sleep patterns. Under these conditions, memory consolidation was found to become chaotic, increasing the REM sleep phase.

A paper regarding prediction errors in episodic memories related to time [38] finds a dual nature to episodic memory recall. It identifies that impaired temporal memory recall implicated in narrative construction is one of the earliest signs of preclinical Alzheimer's disease and mild cognitive impairment. The temporal order of older, inaccurately predicted sequences of memories in a given context is significantly weaker. Concomitantly, an increase in memory strength for the newer memory sequences was observed. This suggests that prediction errors can selectively disrupt episodic memories in the time domain affecting the effective development of narrative.

Point of View. One article considers whether neuroscience can change how morality is viewed [31]. This article claims, when decisions have consequences for future selves, individual differences in narrative construction are visible in the connectivity between the temporal-parietal junction (associated with simulating another perspective) and the caudate (thought to compute decision value) to the extent that people apply the principle that benefit to the neediest should be maximized.

The problem of anosognosia for hemiplegia is considered in relation to the inability of the those affected to consider a point of view other than the one they presuppose [39] in the narratives they construct. In this case, beliefs are updated with counter-facts to maintain the erroneous point of view. In

this regard, patients fail to update their beliefs regarding their motor abilities even when confronted with their severe motor loss during neurological examination, massively compromised daily living abilities, more frequent falls than other stroke patients, as well as ample medical and social feedback.

Discussion

The following discussion is divided into three parts informed by the review of returns from the search of "hippocampus, narrative, mental health." The first concerns the implications with respect to personal narrative of the articles considered in relation to the function of the hippocampus and the type of mental health experienced as a result. The second presents an intervention for promoting personal narrative development that has been particularly effective with health researchers experiencing burnout, referred to as the Health Narratives Research Process, that would, based on this review, have a positive effect on hippocampal function. The final section presents the limitations of this study, identifying areas in need of future research in this regard.

Implications of the articles reviewed

The implications of the articles reviewed will be considered from the perspective of developing personal narratives. Overall, the hippocampus is fundamental to the creation of memory through the development of narrative and changes with respect to its volume, activity (and how that activity can be identified with fMRI tests), construction, and function.

The importance of developing a coherent narrative that corresponds with sense input is found to be crucial with respect to proper sleep in young children [37], the proclivity to remember events in the order they occurred [38], stroke patients being able to identify the fact and extent of their impairment [39], and—with respect to concentration camp survivors—the ability to remember food so that it can be properly digested [35]. In this way, healthy function of the hippocampus has been found in this research to be imperative to maintaining human life.

In this way mental health was found to be intermingled with physical health. This is because the hippocampus defines—through personal narrative—when and where the body is in time and space while identifying who is involved, what is happening, how it is being accomplished, and why an activity is being undertaken. As such, the narrative created through "concept cells" of the hippocampus [34] represents the mental health of the individual both because it plays the pivotal role in the type of morality demonstrated by a person [31], and as a result of changes in the hippocampus affecting the DNA of the individual [26].

Therefore, the role of developing cohesive and robust narratives in individuals is crucial. Although mindfulness [46-48], resilience training [49-51], and the two used in combination [52] have been found helpful in improving mental health, these methods are not directly concerned with improving personal narrative. This is a problem because a lack of coherent and stable personal narrative has been found in the preceding review to affect the volume, activity, construction, and function of the hippocampus. At the same time, unstable and ineffective personal narratives coincide with negative mental health. This has been found in the review to affect patient diagnosis, mental integration and connectivity, spatial and temporal map creation, memory, and point of view adopted.

Regarding the role of the hippocampus in promoting mental health, what is needed is a method that is structured to help individuals construct meaningful personal narratives that can continue to promote positive health outcomes even in challenging circumstances. The Health Narratives Research Process (HeNReP) is one such intervention specifically structured to help create and maintain personally meaningful narratives in researchers under the stressful situation of research burnout, coinciding with the functions of the hippocampus that have been identified with respect to hippocampal mechanisms that simultaneously function to map environmental position and to generate episodic memories.

Health Narratives Research Process

The Heath Narratives Research Process (HeNReP) is a free, non-credit, open-discipline, non-hierarchical process that has been offered in association with the Health, Arts and Humanities Program of the Department of Psychiatry in the University of Toronto since 2015—originally as the Health Narratives Research Group (HeNReG) that ran from the first week in October to the last week in April yearly. The previous HeNReG process has been examined in detail in other publications [16,18-21]. What differentiates the HeNReP from the antecedent HeNReG is that it is not tied to the academic calendar nor to a group meeting, as the process is available to individual participants at any time throughout the calendar year. Participation requires a willingness to participate online using a private Facebook group. Consent is provided by the participant first reading over the information regarding the operation of the group, and then agreeing in writing to participate. The participant understands they are free to leave the process at any time upon participation.

The aim of the process is to help health researchers reduce the burnout that often develops in relation to engaging in their research—where burnout has been defined by the World Health Organization in 2019 as an occupation-specific syndrome resulting from unsuccessfully managed chronic workplace stress characterized by feelings of energy depletion or exhaustion; increased mental distance, feelings of negativism or cynicism related to one's job; and reduced

professional efficacy [53]. The process is accomplished by the researcher self-identifying as experiencing burnout and the facilitator participating in multi-session online structured writing exercises depending on writing prompts that attempt to order their thinking processes regarding their research related to health. This structures their thinking into a narrative.

The Prompts. The first prompt of the process provided by the facilitator is "Describe yourself regarding your research related to health." This prompt represents the story the participant is asked to construct about themselves that is to be the basis of the answers to each of the prompts that follow. The purpose of the prompts to follow this initial one is to take this story and develop it into a narrative with a particular point of view. The aim of the responses to the prompts is to create a structure to the intent of each participant's research program developed in relation to this personally defining story.

The prompts are questions arranged from those that are most objective to those that are increasingly subjective, ordered through questions beginning with "when," "where," "who," "what," "how," and then "why." There are twenty-eight individual prompts, including the first prompt requesting a personal description as a researcher. After the initial prompt, the first four type of questions ("when," "where," "who," "what") each have four distinct prompts; "how" questions have five different prompts, and "why" questions are the topic of six different prompts. The value of ordering writing prompts in this manner has been previously noted [16].

The reason for the number of different prompts being greater than one is that, in focusing on reducing burnout in researchers, the success of the process depends on the researchers achieving a different, and more detailed point of view regarding their story describing themselves regarding their research related to health. Developing this new point of view takes time and practice. Four prompts were decided on in the previous HeNReG (the group process) because they represented a month's worth of weekly practice. The reason both the "how" prompts and the "why" prompts are organized to have more than four is because these prompts in particular relate to the need to establish greater connectivity and interrelation in thought processes in order to be answered, as they are increasingly subjective in this process. This requires additional time for the participant to become comfortable in answering. Furthermore, of the two prompts requiring more than four, the "why" prompts are those associated with developing a moral stance, representing the choices of the participant. This not only requires additional thinking, but it also involves creating a coherent narrative focused on individual obligations [54] (p. 141). Thus, six different prompts were considered appropriate in this regard.

The facilitator poses each of the prompts on the private Facebook group set up for the interaction between the participant and facilitator. Why the private Facebook group was chosen over other online platforms has been noted elsewhere in relation to the previous HeNReG [16,18-21]. These reasons were further reinforced once the group transitioned to a one-on-one process. Once the participant responds to the prompt, the participant is expected to ask an additional question of facilitator (and vice versa) in the private Facebook group, making sure their question begins with the same word as the focus of the particular prompt. In asking the facilitator questions related to the facilitator's response to individual prompts, the participant is able to see the prompt from an additional point of view. The participant is asked to respond with no longer than five minutes of continuous typing. This is to promote the ability of the participants to be clear and concise with their answers.

These ordered prompts correspond directly with healthy hippocampal functions to simultaneously map environmental position and to generate episodic memories. Concerning environmental position, memory is restructured through replying to "when" and "where" questions, and episodic memories are generated though responding to "who," "what," "how," and "why" questions. Robust and effective narratives are developed that are stable and coherent. These directly and easily identify with the workings of the hippocampus that have been found supported in the limited review conducted of "hippocampus, narrative, mental health."

Feedback. Feedback for the HeNReP is formally requested after the final "why" prompt by the facilitator. The participants complete the feedback form recognizing and agreeing in writing that the data of the form may be referenced for academic purposes by the facilitator, always keeping the identities of the participant anonymous.

Reports of the usefulness of the process according to results from the feedback forms while it was the HeNReG have been noted in previous publications by this author [16,18-21]. On the other hand, there has been no report to date on the feedback forms of the HeNReP. That current data will be examined for the first time here.

Responses from three participants are as follows to the question on the feedback form, "How might the HeNReP be of help to you in the future?"

- Self-awareness and assessing my goals when I join a new research project in the future.

- It helped me remind myself that I am much more capable than I think, and know that I have written down what I am interested in health research, it will be nice to be able to go back to that response when I am doubting myself.

- This process helped me clarify my ideas and articulate what about the research process is helpful or unhelpful to me as a researcher. I think that teaching others and presenting new

knowledge/insights is the best way to crystalize concepts learned, explore working hypotheses, or develop questions for future inquiry.

Three responses were received from participants regarding the question on the feedback form, "In what ways was the HeNReP valuable to you as a researcher?"

- Reflective writing project has taught me self-awareness and the improvement I made in research over the years.

- It was helpful to have to set time aside and really reflect on why I was interested in health research. As someone who is only beginning to enter into the job market, it's nice to have a better sense of myself and the type of work I like to do.

- I appreciated the opportunity for self-reflection based on the nuances of the prompt. I felt that there was a real dialogue and that I learned something from the exchange of ideas and personal research practices shared and explained.

A fourth researcher who participated in the process provided their general feedback in the final posting on the private Facebook group.

- I would recommend the health narrative process to other people because it would help to explore one's research in a more wholistic manner, not only in terms of the research process but also in terms of what the research would mean to you and your life personally. I think it's important for a researcher to explore what health research means to them and their life personally because I think that's one thing that keeps people motivated to do what they do. If you don't make the research a part of what you do it will be more difficult to pursue it long term.

This feedback provided by these four researchers who participated in the HeNReP during the 2022/2023 academic year provides continuing reasons to consider the HeNReP useful for helping those health researchers who self-identify as experiencing burnout to develop coherent and stable personal narratives with respect to their research program. Furthermore, the use of the Facebook platform for conducting the HeNReP provides the opportunity for these researchers to refer back to their private postings once the process is complete to reengage with the personal narrative they have constructed during the process.

The HeNReP participants were provided with a structure for ordering their story regarding their research related to health. It is one that corresponds with the functions associated with the hippocampus as the embodied location of narrative construction. It is likely that in improving their mental health by decreasing their burnout, the hippocampal function in these researchers was restructured. This is a result that remains to be tested by future researchers.

Limitations. This study represents merely a limited review. This is because a number of keywords that might have returned additional reports were not included. Some of these are "hippocampal, stories, mental disorder, mental disease, temporal memory, and episodic memory." A full scoping review was not completed since the aim of the investigation was only to provide the direction of studies on the hippocampus. In particular, the concern was narrative and mental health. The purpose in undertaking the review was presenting the type of narrative intervention that has been found helpful to improve mental health specifically in relation to the hippocampus. What this limited review points to is the value of conducting a future scoping review on this topic, which might later lead to a full systematic review, with additional research [22].

Another limitation of this work is that there were only 127 returns related to a combination of the keywords "hippocampus, narrative, mental health" and, of these, merely 14 of the reports were included for assessment. These post-2019 reports were further compromised because a number of them relied on studies that were older than 2019 to support their claims [27,29,30,35,36,38]. As such, future research is required to either substantiate or refute the claims made in those papers that relied on older information to make their assessments.

The evaluation of the articles for their authors' points of view regarding hippocampal function and mental health was contingent on the reading done by this author. This is an additional limitation. Although this author undertook the present study with the aim of objectivity, it is possible that the author had a cognitive bias that was unrecognized [55]. Various frameworks have been developed to debias research. Nevertheless, there remains little research on the efficacy of these models and, as such, how to recognize and reduce cognitive bias is identified as an area in need of additional research [56].

It is also a limitation that changes in hippocampal function of those who participated in the HeNReP were not tested directly. Although, as a result of the limited review conducted, there is reason to believe there was a functional change to the hippocampi of the participants, this is only assumed. What is known is that the burnout the participants had experienced related to their research was brought under control and their mental health improved. Future research is necessary to determine if the type of process of organizing narrative used by the HeNReP does alter the function of participants' hippocampi as well.

The final limitations are those regarding the HeNReP. One is that there have been few returns of the feedback form to provide data on the results for the 2022/2023 academic year. However, there is comparative research that has been published on the previous HeNReG [16,18-21] using the same process, but in a group format, that provides additional

evidence in support of the process. Other researchers interested in developing narrative based on the results of the limited review undertaken here are encouraged to make use of this narrative process developed by the author for their own research programs. To this extent, the second limitation of the HeNReP is that it is a process designed for adults who are researchers. There have been no studies done using this method either on those who don't recognize themselves as researchers or on children. Consequently, the ability of a process like the HeNReP to aid adults who are not researchers, and to aid children, in their narrative development requires investigation in this regard as well.

Conclusions

This investigation was designed to determine the various effects of narrative development through changes in the hippocampus map of environmental position and generated episodic memories on mental health, and to present and discuss a particular intervention to improve mental health using a narrative process. The importance of narrative development to mental health and hippocampal change was examined in relation to a limited review of the keywords "hippocampus, narrative, mental health" of research published since 2019. The results demonstrate the integral and various roles of the hippocampus regarding helping to create a cohesive and potent personal narrative which can be essential to mental health and quality of life. Given this importance, there is a need for successful interventions for narrative development that provide the structure to develop robust and effective narratives that are stable and coherent. The Health Narratives Research Process (HeNReP) has been introduced and examined as one such intervention process that has proven successful with health researchers self-identifying as experiencing burnout. The HeNReP is suggested for further research regarding the connection among the hippocampus, narrative, and mental health.

Funding

This research received no external funding.

Data Availability Statement

No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Conflict of Interest

The author declares no conflict of interest.

References

1. Zawadzki P, Adamczyk AK. To remember, or not to remember? Potential impact of memory modification on narrative identity, personal agency, mental health, and well-being. Bioethics. 2021 Nov;35(9):891-9.

2. Phelps EA, Hofmann SG. Memory editing from science fiction to clinical practice. Nature. 2019 Aug 1;572(7767):43-50.

3. Herzog JI, Thome J, Demirakca T, Koppe G, Ende G, Lis S, Rausch S, Priebe K, Müller-Engelmann M, Steil R, Bohus M. Influence of severity of type and timing of retrospectively reported childhood maltreatment on female amygdala and hippocampal volume. Scientific Reports. 2020 Feb 5;10(1):1903.

4. Robertson S, Carpenter D, Donovan-Hall M, Bartlett R. Using lived experience to develop a personal narrative workshop programme in order to aid mental health recovery. Journal of Mental Health. 2020 Jul 3;29(4):483-91.

5. Koban L, Gianaros PJ, Kober H, Wager TD. The self in context: brain systems linking mental and physical health. Nature Reviews Neuroscience. 2021 May;22(5):309-22.

6. Dimitrova J, Simms LJ. Construct validation of narrative coherence: Exploring links with personality functioning and psychopathology. Personality Disorders: Theory, Research, and Treatment. 2022 Sep;13(5):482.

7. Hannula, DE, Duff, MC, Preface. In: The Hippocampus from Cells to Systems. Hannula DE, Duff MC, Eds.; Springer International Publishing: Cham, 2017; v.

8. Zurawek D, Gruca P, Antkiewicz-Michaluk L, Dziedzicka-Wasylewska M, Resilient phenotype in chronic mild stress paradigm is associated with altered expression levels of miR-18a-5p and serotonin 5-HT1a receptor in dorsal part of the hippocampus. Molecular Neurobiology. 2019 May 16; 56:7680–7693.

9. Alhmoud JF, Woolley JF, Al Moustafa A-E, Malki MI. DNA damage/repair management in cancers. Cancers. 2020; 12(4):1050.

10. Moore G, Audrey S, Barker M, Bond L, Bonell C, Cooper C, et al. Process evaluation in complex public health intervention studies: the need for guidance. J Epidemiol Community Health. 2014 Feb 1;68(2):101-2.

11. Wienert J, Jahnel T, Maaß L. What are digital public health interventions? First steps toward a definition and an intervention classification framework. Journal of Medical Internet Research. 2022 Jun 28;24(6):e31921.

12. Peters MD, Godfrey C, McInerney P, Khalil H, Larsen P, Marnie C, et al. Best practice guidance and reporting items for the development of scoping review protocols. JBI Evidence Synthesis. 2022 Apr 1;20(4):953-68.

13. Danieli K, Guyon A, Bethus I. Episodic Memory formation: A review of complex Hippocampus input pathways. Progress in Neuro-Psychopharmacology and Biological Psychiatry. 2023 Apr 21:110757.

14. Fonagy P, Luyten P, Allison E, Campbell C. Mentalizing, epistemic trust and the phenomenology of psychotherapy. Psychopathology. 2019 Sep 6;52(2):94-103.

15. Maroney DI. The Imagine Project[TM]: Using Expressive Writing

to Help Children Overcome Stress and Trauma. Pediatric nursing. 2020;46(6):300–11.

16. Nash C. Enhancing hopeful resilience regarding depression and anxiety with a narrative method of ordering memory effective in researchers experiencing burnout. Challenges. 2022 Jun 30;13(2):28.

17. Sheehan L, Oexle N, Bushman M, Glover L, Lewy S, Armas SA, et al. To share or not to share? Evaluation of a strategic disclosure program for suicide attempt survivors. Death studies. 2023 Apr 21;47(4):392-9.

18. Nash C. Report on digital literacy in academic meetings during the 2020 COVID-19 lockdown. Challenges. 2020 Sep 7;11(2):20.

19. Nash C. Reconsidering privilege: How to structure writing prompts to develop narrative. Survive & Thrive. A Journal for Medical Humanities and Narrative as Medicine. 2020;5(2):3.

20. Nash C. Online meeting challenges in a research group resulting from COVID-19 limitations. Challenges. 2021 Nov 12;12(2):29.

21. Nash C. Team mindfulness in online academic meetings to reduce burnout. Challenges. 2023 Mar 2;14(1):15.

22. Page MJ, Moher D, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R. PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ . 2021 Mar 29;372.

23. Lockwood C, Dos Santos KB, Pap R. Practical guidance for knowledge synthesis: Scoping review methods. Asian nursing research. 2019 Dec 1;13(5):287-94.

24. Salameh JP, Bossuyt PM, McGrath TA, Thombs BD, Hyde CJ, Macaskill P, et al. Preferred reporting items for systematic review and meta-analysis of diagnostic test accuracy studies (PRISMA-DTA): explanation, elaboration, and checklist. BMJ. 2020 Aug 14;370.

25. Abbott HP. The Cambridge introduction to narrative. Cambridge University Press; 2020 Dec 3.

26. Dee G, Ryznar R, Dee C. Epigenetic changes associated with different types of stressors and suicide. Cells. 2023 Apr 26;12(9):1258.

27. Siegel DJ, Drulis C. An interpersonal neurobiology perspective on the mind and mental health: personal, public, and planetary well-being. Annals of General Psychiatry. 2023 Feb 3;22(1):5.

28. Traynor JM, Wrege JS, Walter M, Ruocco AC. Dimensional personality impairment is associated with disruptions in intrinsic intralimbic functional connectivity. Psychological Medicine. 2023 Mar;53(4):1323-33.

29. Raver JL, McElheran M. A trauma-informed approach is needed to reduce police misconduct. Industrial and Organizational Psychology. 2022 Dec;15(4):583-7.

30. Magni LR, Carcione A, Ferrari C, Semerari A, Riccardi I, Nicolo' G, et al. Neurobiological and clinical effect of metacognitive interpersonal therapy vs structured clinical model: study protocol for a randomized controlled trial. BMC Psychiatry. 2019 Dec;19:1-1.

31. Kelly C, O'Connell R. Can neuroscience change the way we view morality? Neuron. 2020 Nov 25;108(4):604-7.

32. Larner AJ. Investigation of TGA (1): Neuropsychology, neurophysiology and other investigations. In: Transient Global Amnesia: From Patient Encounter to Clinical Neuroscience. Cham: Springer International Publishing; 2022 Jun 11. pp. 65-80.

33. Stoyanov D, Kandilarova S, Paunova R, Barranco Garcia J, Latypova A, Kherif F. Cross-validation of functional MRI and paranoid-depressive scale: Results from multivariate analysis. Frontiers in Psychiatry. 2019 Nov 25;10:869.

34. Thorpe L. Atomic event concepts in perception, action, and belief. Journal of the American Philosophical Association. 2022 Mar;8(1):110-27.

35. Pine L. Food memory and food imagination at Auschwitz. Food in memory and imagination. Space, Place and, Taste. 2022 Jan 13:109-122.

36. Michelmann S, Staresina BP, Bowman H, Hanslmayr S. Speed of time-compressed forward replay flexibly changes in human episodic memory. Nature Human Behaviour. 2019 Feb;3(2):143-54.

37. Sriyanah N, Efendi S, Syatiani S, Nurleli N, Nurdin S. Relationship between hospitalization stress and changes in sleep patterns in children aged 3-6 years in the Al-Fajar Room of Haji Hospital, Makassar. International Journal of Health Sciences. 2022 Mar(IV):608-18.

38. Yazin F, Das M, Banerjee A, Roy D. Contextual prediction errors reorganize naturalistic episodic memories in time. Scientific Reports. 2021 Jun 11;11(1):12364.

39. Kirsch LP, Mathys C, Papadaki C, Talelli P, Friston K, Moro V, Fotopoulou A. Updating beliefs beyond the here-and-now: the counter-factual self in anosognosia for hemiplegia. Brain Communications. 2021 Apr 1;3(2):fcab098.

40. Schöberl F, Irving S, Pradhan C, Bardins S, Trapp C, Schneider E, Kugler G, Bartenstein P, Dieterich M, Brandt T, Zwergal A. Prolonged allocentric navigation deficits indicate hippocampal damage in TGA. Neurology. 2019 Jan 15;92(3):e234-43.

41. Bein O, Duncan K, Davachi L. Mnemonic prediction errors bias hippocampal states. Nature Communications. 2020 Jul 10;11(1):3451.

42. Nestler EJ. Transgenerational epigenetic contributions to stress responses: fact or fiction? PLoS Biology. 2016 Mar 25;14(3):e1002426.

43. Skinner MK. Environmental stress and epigenetic transgenerational inheritance. BMC Medicine. 2014 Dec;12(1):1-5.

44. Švorcová J. Transgenerational epigenetic inheritance of traumatic experience in mammals. Genes. 2023 Jan 1;14(1):120.

45. Larner AJ. The usage of cognitive screening instruments: Test characteristics and suspected diagnosis. In: Cognitive Screening Instruments. Cham: Springer International Publishing; 2017:315-39.

46. Shankland R, Tessier D, Strub L, Gauchet A, Baeyens C. Improving mental health and well-being through informal mindfulness

practices: an intervention study. Applied Psychology: Health and Well-Being. 2021 Feb;13(1):63-83.

47. Gál É, Ștefan S, Cristea IA. The efficacy of mindfulness meditation apps in enhancing users' well-being and mental health related outcomes: a meta-analysis of randomized controlled trials. Journal of Affective Disorders. 2021 Jan 15;279:131-42.

48. Zhu JL, Schülke R, Vatansever D, Xi D, Yan J, Zhao H, et al. Mindfulness practice for protecting mental health during the COVID-19 pandemic. Translational Psychiatry. 2021 May 28;11(1):329.

49. Scheuch I, Peters N, Lohner MS, Muss C, Aprea C, Fürstenau B. Resilience training programs in organizational contexts: A scoping review. Frontiers in Psychology. 2021 Oct 14;12:4489.

50. Rieckert A, Schuit E, Bleijenberg N, Ten Cate D, de Lange W, de Man-van Ginkel JM, et al. How can we build and maintain the resilience of our health care professionals during COVID-19? Recommendations based on a scoping review. BMJ Open. 2021 Jan 1;11(1):e043718.

51. Ungar M, Theron L. Resilience and mental health: How multisystemic processes contribute to positive outcomes. The Lancet Psychiatry. 2020 May 1;7(5):441-8.

52. Christopher M, Bowen S, Witkiewitz K. Mindfulness-based resilience training for aggression, stress and health in law enforcement officers: study protocol for a multisite, randomized, single-blind clinical feasibility trial. Trials. 2020 Dec;21(1):1-2.

53. World Health Organization. Burn-out an "occupational phenomenon": International Classification of Diseases. May 28, 2019.

54. Igneski V. Individual duties in unstructured collective contexts. Collectivity: ontology, ethics, and social justice. 2018 Nov 2:133:3-152.

55. Neal T, Lienert P, Denne E, Singh JP. A general model of cognitive bias in human judgment and systematic review specific to forensic mental health. Law and Human Behavior. 2022 Apr;46(2):99.

56. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, Moher D, Peters MDJ, Horsley T, Weeks L, et al. PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. Annals of Internal Medicine. 2018 Sept 4:169:467-73.